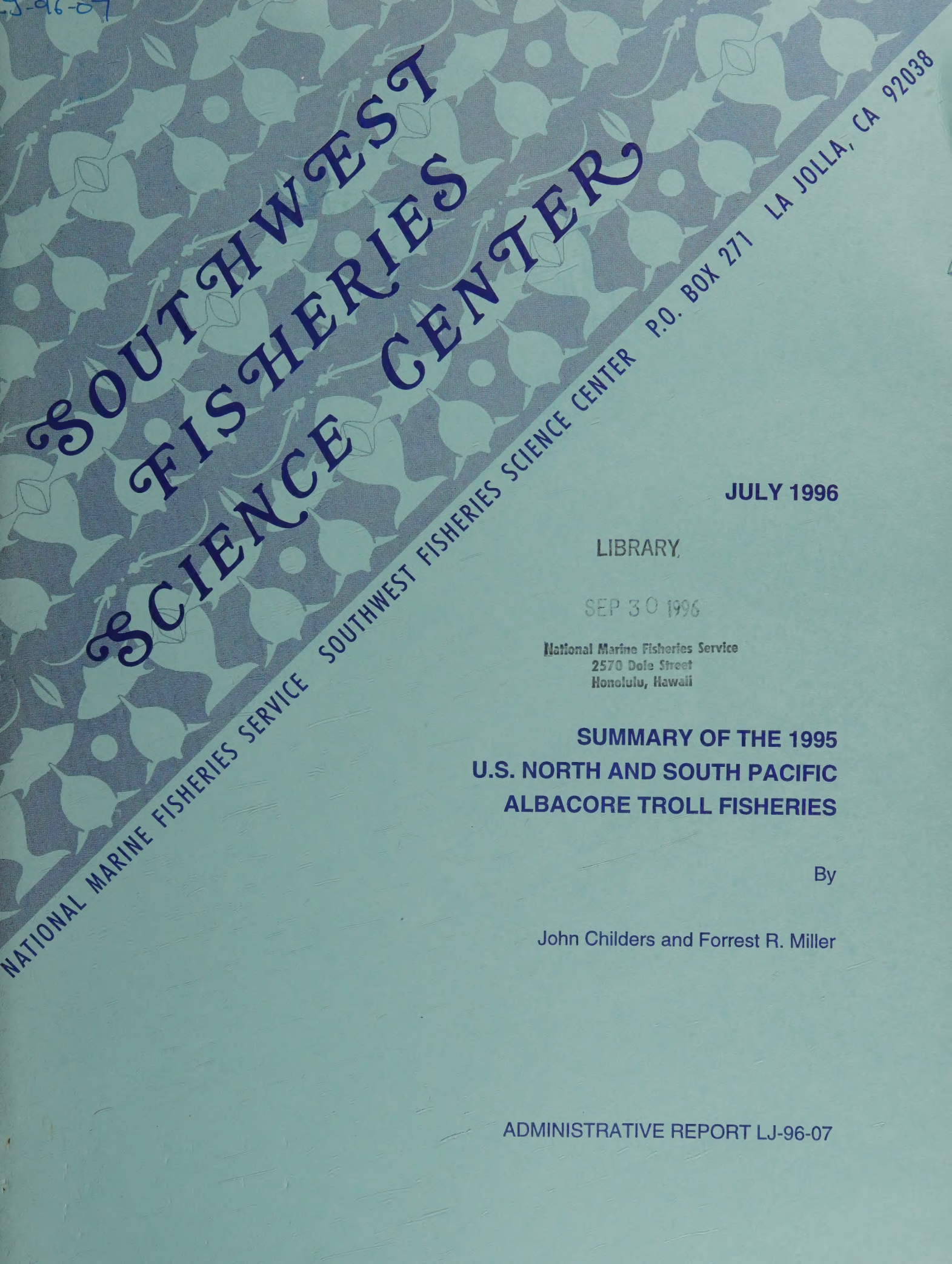


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## **SUMMARY OF THE 1995 U.S. NORTH AND SOUTH PACIFIC ALBACORE TROLL FISHERIES**

By

John Childers and Forrest R. Miller

ADMINISTRATIVE REPORT LJ-96-07

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# **SUMMARY OF THE 1995 U.S. NORTH AND SOUTH PACIFIC ALBACORE TROLL FISHERIES<sup>1</sup>**

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**JULY 1996**

**ADMINISTRATIVE REPORT LJ-96-07**

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# SUMMARY OF THE 1995 U.S. NORTH AND SOUTH PACIFIC ALBACORE TROLL FISHERIES

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## INTRODUCTION

Each year U.S. troll vessels that fish for albacore (*Thunnus alalunga*) in the North Pacific catch 4% to 40% of the total reported amount of albacore landed by all North Pacific fisheries (Table 1). The season begins as early as April, in areas northwest of Hawaii between latitudes 30°N and 40°N; vessels fish eastward as the season progresses. In 1995, U.S. albacore landings were approximately 20% of total landings. During the past 40 years, the distribution of the fishery has shifted farther north, larger troll vessels with increased carrying capacity and increased range have joined the fleet, and the fishing area has expanded to include areas west of the international dateline.

Exploratory troll fishing in areas east of New Zealand in 1986 resulted in the development of a U.S. South Pacific albacore troll fishery that began in 1987 (Laurs et. al., 1987). This fishery takes place during the austral summer months (December through April). The fishery annually takes less than 10% of the total amount of albacore reported caught by all South Pacific fisheries (Table 2). U.S. landings from the 1994-95 season represent approximately 6% of the total tonnage of albacore caught in the South Pacific in 1995. U.S. troll vessels that are capable of reaching the South Pacific fishing areas depart the U.S. west coast or Hawaii after the end of the North Pacific season and travel to American Samoa or French Polynesia to prepare for the South Pacific season. The fishing areas extend from the west coast of New Zealand to approximately 110°W between 25°S and 45°S. Most vessels unload in Pago Pago, American Samoa and travel to Hawaii or the U.S. west coast in March or April to prepare for the North Pacific fishing season.

The Southwest Fisheries Science Center (SWFSC) of the National Marine Fisheries Service (NMFS), in cooperation with American Fishermen's Research Foundation (AFRF), Western Fishboat Owners Association (WFOA), Pacific States Marine Fisheries Commission (PSMFC), and the state fisheries agencies of California, Oregon, and Washington, maintains a program for collecting landings, logbook and length-frequency information from the albacore troll fisheries. Catch and effort data are obtained from completed copies of the *U.S. Pacific Albacore Logbook*, that are voluntarily submitted by fishermen, or completed by port samplers who collect information from cooperating fishermen. Over five hundred logbooks were distributed to albacore fishermen prior to, and during the 1995 North Pacific and the 1994-95 South Pacific albacore seasons by NMFS and cooperating agencies. Length-frequency data were collected by

samplers at major landing ports. Landings data were collected from landings receipts. A biologist collected logbook, length-frequency, and related fishing information aboard two fishing vessels during the 1995 North Pacific season.

This report summarizes the catch, effort, landings and length-frequency information collected from the 1995 North Pacific and the 1994-95 South Pacific albacore seasons. Data from the 1994 North Pacific season, 1993-94 South Pacific season, and from foreign albacore fisheries (where available) are included for comparison.

### **LOGBOOK SAMPLING COVERAGE**

The method used for computing logbook sampling coverage rates was modified in 1996 to allow consistent comparisons between early years' and recent years' coverage rates. Logbook sampling coverage rates are the ratio of landings from sampled trips (those trips from which logbook data were received) to the total landings. Landings from sampled trips are estimated by multiplying numbers of fish caught (recorded in logbooks) by the average weight of those fish and summing these estimates from sampled logbooks.

A total of 348 trips (of approximately 907 total trips completed during the 1995 North Pacific season) were sampled for logbook information. Sampled trips caught 4,963 metric tons (t) of albacore, resulting in a logbook sampling coverage rate of 52%, compared to 42% for 1994 (Table 3).

Logbook information for the 1994-95 South Pacific season were collected from 22 trips of the 47 trips completed. These 22 trips caught a total of 1,223 t of albacore. The logbook sampling coverage rate was 53% compared to 52% for the 1993-94 season (Table 4). More at-sea transshipments of catches in recent years have hampered efforts to collect logbook information from troll vessels fishing in the South Pacific.

### **LENGTH-FREQUENCY SAMPLING COVERAGE**

Length-frequency sampling coverage rates are calculated as the ratio of the number of fish sampled (measured) to the total number of fish landed for the season (total number of fish landed for the season is estimated by dividing total landings by average weight). More than 24,000 albacore were measured during the 1995 North Pacific season compared to 18,533 fish measured (mostly by biologists accompanying troll vessels) in 1994. Length-frequency sampling coverage for the 1995 North Pacific season is 1.7% compared to 1.2% coverage in 1994 (Table 3). Port sampling for length-frequency data was re-instated in 1995 after being suspended during the 1993 and 1994 North Pacific seasons.

Length-frequency data for the 1994-95 South Pacific albacore fishery were collected by port samplers in Pago Pago, American Samoa. Port samplers measured 1,460 albacore during the season, resulting in a length-frequency sampling coverage rate of 0.4%. The length-frequency coverage rate for the 1993-94 season was 1.1% (Table 4). The collection of length-frequency data from South Pacific albacore catches (as with the logbook data collection) was hampered by the frequent transshipment of catches and few direct landings available to be sampled.

## TOTAL CATCH AND EFFORT

Total fishing effort for the Pacific albacore troll fisheries is estimated by dividing total landings (in pounds) by catch-per-unit effort (CPUE in numbers of fish per day) then dividing by average weight (in pounds). More than 500 troll vessels fished approximately 28,560 days during the 1995 North Pacific albacore season, a 33% increase from 21,489 days fished during the 1994 season (Table 3). Total landings from the 1995 North Pacific albacore season were 9,486 t compared to 10,978 t landed in 1994. In comparison the Japanese pole-and-line fleet in the North Pacific landed approximately 23,700 t of albacore in 1995, slightly less than 26,391 t reported for 1994.

Twenty-one troll vessels participated in the 1994-95 South Pacific albacore fishery. These vessels fished more than 1,900 days compared to 916 days by 12 U.S. vessels in 1993-94 (Table 4). Total U.S. landings for 1994-95 increased 338% to 2,319 t from 530 t landed in 1993-94. The 1994-95 total is the highest since the 1990-91 season. Estimates of albacore landings by foreign fisheries operating in the South Pacific are listed in Table 2.

## DISTRIBUTION OF CATCHES

The areas of highest reported catches from the 1995 North Pacific season were near 35°N, 177°W, near 41°N, 151°W, and near 44°N, 145°W (Figure 1a). The 1995 North Pacific albacore season began in April when troll vessels fished in areas north of Midway Island. Catch locations in April ranged from 169°E to 165°W, between 29°N and 33°N (Figure 1b). The fishery expanded in May as more troll vessels entered the fishery and fished in areas north of Midway. Most catches occurred between 166°E and 166°W from 30°N to 37°N (Figure 1c). Catches in June were centered between 174°E and 168°W from 34°N to 39°N (Figure 1d) although scattered catches were reported between 135°W and 144°W from 35°N to 43°N. Much of July's catches were distributed east of 160°W (Figure 1e). Catches were best between 145°W and 152°W from 41°N to 43°N. Catch locations in August extended from the West Coast to 155°W (Figure 1f). Catches greater than 24,000 fish for the month were made between 43°N and 46°N and 144°W and 150°W. Catches in September were more widely disbursed but most fishing again occurred between the West Coast and 145°W (Figure 1g). The highest reported catches in September were located near 46°N, 143°W and 49°N, 128°W (west of Vancouver Island). Poor weather predominated in October and catches were widely disbursed (Figure 1h).

The highest catches recorded by troll vessels during the 1994-95 South Pacific season were made between 160°W and 170°W and between 35°S and 40°S (Figure 2a). The 1994-95 South Pacific albacore season began in December 1994. During this month, catches were reported between 155°W and 175°W from 30°S to 40°S (Figure 2b). Catches in January occurred between 145°W and the International Dateline with the highest catches recorded between 160°W and 165°W from 35°S to 40°S (Figure 2c). Catches in February were located between 150°W and 180° from 35°S to 40°S, but the highest catches occurred between 165°W and 170°W (Figure 2d). Catches were more widely disbursed in March extending from 145°W to 180° and from 25°S to 45°S (Figure 2e). The only catches recorded in April were located between 150°W and 155°W from 35°S to 40°S (Figure 2f).

## CATCH-PER-UNIT EFFORT

Catch-Per-Unit Effort (CPUE) for Pacific albacore troll fisheries is expressed as numbers of fish caught per day of fishing. CPUE is used as an indication of relative abundance of albacore available to troll gear and an indicator of fishing success. Catch (in numbers of fish) and effort (in days fished) were summarized by 10-day, 1°-square strata in which there was at least one day of fishing effort (Kleiber and Perrin, 1991). CPUE values for each month of the North Pacific season were calculated by averaging the CPUE values of all strata within a respective month. The general equation for the calculation of CPUE is:

$$\text{Average CPUE} = \frac{1}{n} \sum \left( \frac{\sum C_i}{\sum E_i} \right)$$

Where  $C_i$  is the total sampled catch in the  $i^{\text{th}}$  strata,  $E_i$  is the total sampled effort in the  $i^{\text{th}}$  strata, and  $n$  is the total number of strata.

CPUE averaged for the 1995 North Pacific season is 49 fish/day. This is a decrease from 70 fish/day computed for the 1994 season<sup>2</sup> (Table 3). The average CPUE for the 1994-95 South Pacific season increased to 170 fish per day from 98 fish per day in 1993-94 (Table 4).

## DISTRIBUTION OF CPUE

Average CPUE's for the 1995 North Pacific season were highest between 141°W and 153°W from 41°N to 48°N and in a smaller area between 156°W and 162°W from 40°N to 43°N (Figure 3a). CPUE's for North Pacific troll vessels in April were less than 150 fish per day in the areas north of Midway Island (Figure 3b). CPUE's remained below 150 fish/day in May, except at 34°N, 177°E where they ranged from 151 to 300 fish/day (Figure 3c). CPUE's between 151 fish/day and 300 fish/day were located at 33°N, 180° and near 174°E between 35°N and 39°N in June (Figure 3d). CPUE's again increased in July as vessels fished farther east. The highest CPUE's were distributed between 140°W and 160°W from 40°N to 51°N (Figure 3e). High CPUE's in August were concentrated between 143°W and 153°W from 40°N to 48°N (Figure 3f). CPUE's decreased in September, only exceeding 150 fish per day between 142°W and 151°W from 44°N to 48°N (Figure 3g). CPUE's averaged less than 150 fish per day in all the sampled areas in October (Figure 3h).

The highest average CPUE's for the 1994-95 South Pacific season (greater than 174 fish/day) were distributed between 160°W and 170°W from 35°S to 40°S (Figure 4a). CPUE's for troll vessels that fished in the South Pacific in December 1994 ranged from 90 to 177 fish/day between 160°W and 175°W from 35°S to 40°S (Figure 4b). CPUE's greater than 267 fish/day were distributed between 160°W and 165°W from 35°S to 40°S in January 1995 (Figure 4c) but averaged less than 90 fish/day in most of the sampled areas. CPUE's increased in February, exceeding 267 fish/day between 165°W and 170°W and between 150°W and 155°W from 35°S

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<sup>2</sup> CPUE values for past seasons may differ from previously published values due to updates in catch/effort data and refined computational methods.

to 40°S (Figure 4d). The highest CPUE's in March averaged between 90 and 177 fish/day and were distributed between 150°W and 170°W from 25°S to 45°S (Figure 4e). Average CPUE's in April were between 1 and 89 fish/day and were distributed between 150°W and 155°W from 35°S to 40°S (Figure 4f).

## **LENGTH-FREQUENCIES**

Length-frequency data from the 1995 North Pacific season were collected by port samplers in the ports of Westport, Ilwaco, Astoria, Newport, Crescent City, Eureka, Terminal Island, and Pago Pago, and by a biologist aboard two troll vessels. Nearly 16,000 albacore were measured by port samplers and 8,460 by a NMFS biologist at sea during the 1995 North Pacific season. The average fork length of albacore caught during the 1995 North Pacific season was 69 cm (15 lbs or 6.7 kg) compared to an average fork length of 71 cm (16 lbs or 7.3 kg) for the 1994 season (length-weight conversions from Bartoo and Foreman, 1993). Fork lengths of albacore sampled from North Pacific catches range from 48 cm to 102 cm. Three modes are evident in the length-frequency histogram of measured fish (Figure 5): a smaller mode is centered at 58 cm fork length, the most prominent mode is centered at 64 cm and a third, distinct mode is centered at 79 cm. These modes correspond to approximately 2, 3, and 4 year-old fish, respectively (Length-age conversions from Bartoo and Foreman, 1993).

Port samplers in American Samoa measured 1,460 albacore from troll vessel landings during the 1994-95 South Pacific season. The low number of vessels participating in the 1994-95 fishery and the large number of at-sea transshipments limited the amount of fish available to be measured. The average fork length of sampled albacore from 1994-95 landings is 70 cm (15.5 lbs or 7.0 kg) compared to an average fork length of 66 cm (13 lbs or 5.9 kg) for albacore measured during 1993-94 (length-weight conversions from Bartoo and Foreman, 1993). Fork lengths of albacore that were measured in 1994-95 ranged from 47 cm to 103 cm. Several modes appear in the length-frequency histogram of sampled fish, but two are distinct: one centered at 62 cm and another centered at 73 cm (Figure 6). These modes correspond, approximately, to 3 year-old fish and 5 year-old fish, respectively (length-age conversion from Labelle, et. al. 1993).

## **DISTRIBUTION OF LENGTH-FREQUENCIES**

Length-frequencies from the 1995 North Pacific season and 1994-95 South Pacific season were summarized by 5°x10° quadrangles. Three size modes are equally represented in fish caught along the U.S. West Coast during the 1995 North Pacific season (Figure 7). Larger fish are more abundant in samples from areas off Vancouver Island. Two size modes centered at 64 cm and 77 cm are evident in the histograms of fish caught in the offshore area between 140°W and 160°W. Smaller fish are most abundant in samples from 45°N, 140°W, 40°N, 150°W, and 35°N, 170°E while larger fish are most abundant in samples from 45°N, 150°W.

Fish measured during the 1994-95 South Pacific season were caught between 140°W and 170°W from 30°S to 35°S (Figure 8). Two modes, centered near 63 cm and 73 cm, are equally represented in the three areas that were summarized.

## SEA SURFACE TEMPERATURES AND SAMPLED CATCHES

North Pacific sea surface temperatures (SST's) recorded from commercial transport ships, fishing vessels and research vessels, were compiled into monthly means and computer-analyzed. Contours of SST's were drawn with 1° latitude and longitude resolution. Analysis of the mean SST's show the distribution of isotherms and the locations of ocean fronts (Figures 9a through 9g). Catch areas recorded by the North Pacific albacore fleet each month are shaded on the corresponding SST charts to show the relationship between areas of fishing, ocean fronts and SST isotherms. SST information from the 1994-95 South Pacific fishery is not available.

In April 1995 the North Pacific albacore season began north of Midway Island (Figure 9a) between 170°E and 165°W where near normal SST's were 15°C to 18°C (59°F to 64°F). During May fishing activity expanded markedly to a large region from 30°N to 37°N between 150°E and 140°W (Figure 9b). In this elongated, mid-Pacific region SST's were, on average, 15°C to 18°C (59°F to 64°F). These temperatures were 1°C to 2°C (1.8°F to 3.6°F) below normal. In June fishing activity was concentrated from 35°N to 40°N between 175°E and 160°W with some fishing around 140°W (Figure 9c). Here fishing was most active, as in May, along the southern edge of the subarctic front between the 15°C and 18°C (59°F and 64°F) isotherms which again were 1°C to 2°C (1.8°F to 3.6°F) below normal and were displaced further south than usual. During July the albacore fishing areas shifted northward to regions between 37°N and 45°N, from the international dateline to the West Coast, between California and Washington (Figure 9d). West of 140°W, fishing continued to be concentrated along the southern edge of the subarctic ocean front in 14°C to 17°C (57°F to 63°F) waters that were 2°C to 3°C (3.6°F to 5.4°F) below normal in July. During this period, some of the fleet began fishing in the areas west of Washington and Oregon in 15°C to 17°C (59°F to 63°F) waters that were 1°C to 2°C (1.8°F to 3.6°F) above normal. In August 1995 the albacore fleet was distributed east of 155°W from 42°N to 47°N and along the West Coast from Oregon to Vancouver Island (Figure 9e). At this time coastal fishing occurred in near-normal SST's of 13°C to 15°C (55°F to 59°F) and was distributed along strong frontal boundaries that extended northward from the inshore areas of central California to the waters off Vancouver Island. The tight packing of isotherms that ran North-South was associated with coastal upwelling of colder, nutrient-rich subsurface water. The most concentrated fishing continued about 1,500 miles west of the Pacific Coast between 145°W and 155°W where SST's remained 1°C above normal. During September most of the fleet were fishing in the coastal area from central California to Vancouver Island where SST's ranged from 15°C to 18°C (59°F to 64°F) about 1°C above normal (Figure 9f). Some fishing activity continued in the offshore area north of 43°N between 140°W and 130°W in 15°C to 18°C (59°F and 64°F) water that was 1°C below normal. By October the ocean frontal boundaries had weakened off the West Coast and the fleet was scattered offshore from Oregon to Vancouver Island in waters with slightly above-normal SST's of 15°C to 18°C (59°F and 64°F) (Figure 9g).

## SUMMARY

The 1995 North Pacific U.S. troll fishery caught approximately 20% of the albacore landings reported by all North Pacific albacore fisheries. Logbook sampling coverage and length-frequency sampling coverage for the 1995 North Pacific albacore fishery increased to 52% and 1.7%, respectively. More than 500 U.S. troll vessels expended 28,560 days of effort and landed a total of 9,486 t during the 1995 North Pacific season. The 1995 North Pacific albacore season

began in April north of Midway Island and ended in October off the West Coast. Troll vessel catch locations ranged from the West Coast to areas west of the International Dateline. The highest sampled catches during the season were centered near 44°N, 145°W, near 41°N, 151°W and near 35°N, 177°W. The average CPUE for the 1995 season decreased to 49 fish/day from 70 fish/day during the 1994 season. The highest CPUE values were distributed between 140°W and 160°W and between 41°N and 48°W. More than 24,000 albacore were measured during the season. The average fork length of fish caught by troll vessels was 69 cm (15 lbs or 6.8 kg) and they ranged from 48 cm to 102 cm. Well-defined modes were centered at 64 cm and 79 cm with a weaker mode at 58 cm. Areas of concentrated fishing were along the southern edge of the subarctic ocean front where isotherms were between 15°C and 18°C (59°F and 64°F).

The 1994-95 South Pacific U.S. troll fishery caught approximately 6% of the albacore landed by all South Pacific albacore fisheries. Logbook sampling coverage and length-frequency sampling coverage were 53% and 0.4%, respectively. The fishery was composed of 21 troll vessels that expended 1,941 days of effort and landed 2,319 t of albacore. The season began in December 1994 and ended in April 1995. Catches were distributed between 145°W and 180° and between 25°S and 45°S with highest catches reported between 160°W and 170°W from 35°S to 40°S. The average CPUE for the 1994-95 season increased to 170 fish/day from 98 fish/day in 1993-94. The highest CPUE values were located between 160°W and 170°W from 35°S to 40°S. A total of 1,460 albacore were measured during the season. Fork lengths of measured fish range from 47 cm to 103 cm fork length, and average 70 cm (15.5 lbs or 7.0 kg). Two length-frequency modes, centered at 62 cm and 73 cm, were prominent in the samples.

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Table 1. Landings of North Pacific albacore in metric tons by fisheries, 1952-1995. Provisional estimates are given in parentheses.  
 -- indicates data not available. (0) indicates less than 1 metric ton.

| YEAR | JAPAN <sup>1</sup> |           |          |             | TAIWAN <sup>4</sup> |           | KOREA <sup>2</sup> |           | UNITED STATES <sup>3</sup> |       |          |             |            | CANADA | MEXICO     |             |
|------|--------------------|-----------|----------|-------------|---------------------|-----------|--------------------|-----------|----------------------------|-------|----------|-------------|------------|--------|------------|-------------|
|      | POLE & LINE        | LONG LINE | GILL NET | PURSE SEINE | OTHER GEAR          | LONG LINE | GILL NET           | LONG LINE | TROLL                      | SPORT | GILL NET | PURSE SEINE | OTHER GEAR | TROLL  | OTHER GEAR | GRAND TOTAL |
| 1952 | 41,786             | 26,687    |          | 154         | 237                 |           |                    |           | 23,843                     | 1,373 |          |             |            | 71     |            | 94,151      |
| 1953 | 32,921             | 27,777    |          | 38          | 132                 |           |                    |           | 15,740                     | 171   |          |             |            | 5      |            | 76,784      |
| 1954 | 28,069             | 20,958    |          | 23          | 38                  |           |                    |           | 12,246                     | 147   |          |             |            |        |            | 61,481      |
| 1955 | 24,236             | 16,277    |          | 8           | 136                 |           |                    |           | 13,264                     | 577   |          |             |            |        |            | 54,498      |
| 1956 | 42,810             | 14,341    |          |             | 57                  |           |                    |           | 18,751                     | 482   |          |             |            | 17     |            | 76,458      |
| 1957 | 49,500             | 21,053    |          | 83          | 151                 |           |                    |           | 21,165                     | 304   |          |             |            | 8      |            | 92,264      |
| 1958 | 22,175             | 18,432    |          | 8           | 124                 |           |                    |           | 14,855                     | 48    |          |             |            | 74     |            | 55,716      |
| 1959 | 14,252             | 15,802    |          |             | 67                  |           |                    |           | 20,990                     | 0     |          |             |            | 212    |            | 51,328      |
| 1960 | 25,156             | 17,369    |          |             | 76                  |           |                    |           | 20,100                     | 557   |          |             |            | 5      |            | 63,267      |
| 1961 | 18,636             | 17,437    |          | 7           | 268                 |           |                    |           | 12,055                     | 1,355 |          |             |            | 4      |            | 52,605      |
| 1962 | 8,729              | 15,764    |          | 53          | 191                 |           |                    |           | 19,752                     | 1,681 |          |             |            | 4      |            | 47,264      |
| 1963 | 26,420             | 13,464    |          | 59          | 218                 |           |                    |           | 25,140                     | 1,161 |          |             |            | 1      |            | 68,906      |
| 1964 | 23,858             | 15,458    |          | 128         | 319                 |           |                    |           | 18,388                     | 824   |          |             |            | 5      |            | 62,419      |
| 1965 | 41,491             | 13,701    | 26       |             |                     | 261       |                    |           | 16,542                     | 731   |          |             |            | 3      |            | 73,293      |
| 1966 | 22,830             | 25,050    | 11       | 111         | 585                 | 271       |                    |           | 15,333                     | 588   |          |             |            | 15     |            | 66,421      |
| 1967 | 30,481             | 28,869    | 89       | 111         | 520                 | 271       |                    |           | 17,814                     | 707   |          |             |            | 44     |            | 83,401      |
| 1968 | 16,597             | 23,961    | 635      | 267         | 1,109               | 698       |                    |           | 20,434                     | 951   |          |             |            | 161    |            | 69,961      |
| 1969 | 32,107             | 18,006    | 634      | 521         | 1,480               |           |                    |           | 18,827                     | 358   |          |             |            | 1,028  |            | 76,306      |
| 1970 | 24,376             | 15,372    |          | 317         | 794                 | 1,516     |                    |           | 21,032                     | 822   |          |             |            | 354    |            | 69,008      |
| 1971 | 53,198             | 11,035    |          | 902         | 367                 | 1,759     |                    |           | 20,526                     | 1,175 |          |             |            | 1,587  |            | 92,631      |
| 1972 | 60,762             | 12,649    |          | 277         | 646                 | 3,091     |                    |           | 23,600                     | 637   |          |             |            | 3,558  |            | 109,079     |
| 1973 | 69,811             | 16,059    |          | 1,353       | 533                 | 128       |                    |           | 15,653                     | 84    |          |             |            | 1,270  | 100        | 107,180     |
| 1974 | 73,576             | 13,053    | 39       |             |                     | 570       |                    |           | 20,178                     | 94    |          |             |            | 1,207  | 1          | 114,809     |
| 1975 | 52,157             | 10,060    | 166      | 159         | 254                 | 1,494     |                    |           | 18,932                     | 640   |          |             |            | 101    | 1          | 89,713      |
| 1976 | 85,336             | 15,896    | 1,070    | 1,109       | 285                 | 1,251     |                    |           | 15,905                     | 713   |          |             |            | 252    | 36         | 125,439     |
| 1977 | 31,934             | 15,737    | 688      | 669         | 379                 | 873       |                    |           | 9,969                      | 537   |          |             |            | 53     | 0          | 63,164      |
| 1978 | 59,877             | 13,061    | 4,029    | 1,115       | 2,097               | 284       |                    |           | 16,613                     | 810   |          |             |            | 23     | 1          | 99,157      |
| 1979 | 44,662             | 14,249    | 2,856    | 125         | 1,158               | 187       |                    |           | 6,781                      | 74    |          |             |            | 521    | 1          | (71,207)    |
| 1980 | 46,743             | 14,743    | 2,986    | 329         | 1,209               | 318       |                    |           | 7,556                      | 168   |          |             |            | 212    | 31         | (75,304)    |
| 1981 | 27,426             | 18,020    | 10,348   | 252         | 904                 | 339       | --                 | 597       | 12,637                     | 195   |          |             |            | 200    | 8          | (71,612)    |
| 1982 | 29,615             | 16,762    | 12,511   | 561         | 732                 | 559       | --                 | 459       | 6,609                      | 257   |          |             |            | 104    | 7          | (68,726)    |
| 1983 | 21,098             | 15,103    | 6,852    | 350         | 125                 | 520       | --                 | 387       | 9,359                      | 87    |          |             |            | 225    | 33         | (55,259)    |
| 1984 | 26,015             | 15,111    | 8,988    | 3,380       | 518                 | 471       | --                 | 454       | 9,304                      | 1,427 |          |             |            | 50     | 113        | (70,925)    |
| 1985 | 20,714             | 12,320    | 11,204   | 1,533       | 407                 | 109       | --                 | 291       | 6,415                      | 1,176 |          |             |            | 56     | 49         | (58,433)    |
| 1986 | 16,096             | 12,945    | 7,813    | 1,542       | 650                 | --        | --                 | 241       | 4,708                      | 196   |          |             |            | 30     | 7          | (45,491)    |
| 1987 | 19,091             | 14,842    | 6,698    | 1,205       | 189                 | --        | 2,514              | 182       | 2,766                      | 74    |          |             |            | 104    | 7          | (48,588)    |
| 1988 | 6,216              | 13,904    | 9,074    | 1,208       | 177                 | 38        | 7,389              | 109       | 4,212                      | 64    |          |             |            | 155    | 15         | (44,508)    |
| 1989 | 8,629              | 13,194    | 7,437    | 2,521       | 466                 | 544       | 8,350              | 81        | 1,860                      | 160   |          |             |            | 200    | 2          | (44,797)    |

Table 1. (continued)

| YEAR | JAPAN <sup>1</sup> |           |          |             |            | TAIWAN <sup>4</sup> |          | KOREA <sup>2</sup> |          | UNITED STATES <sup>3</sup> |         |       |          |             | CANADA     | MEXICO | GRAND TOTAL |            |
|------|--------------------|-----------|----------|-------------|------------|---------------------|----------|--------------------|----------|----------------------------|---------|-------|----------|-------------|------------|--------|-------------|------------|
|      | POLE & LINE        | LONG LINE | GILL NET | PURSE SEINE | OTHER GEAR | LONG LINE           | GILL NET | LONG LINE          | GILL NET | BAIT BOAT                  | TROLL   | SPORT | GILL NET | PURSE SEINE | OTHER GEAR | TROLL  |             | OTHER GEAR |
| 1990 | 8,532              | 15,928    | 6,064    | 1,995       | 253        | 287                 | 16,701   | 20                 | (1,016)  | 115                        | 2,603   | 24    | 29       | 71          | 181        | 302    | 2           | (54,123)   |
| 1991 | 7,103              | 10,379    | 3,401    | 2,652       | 399        | 353                 | 3,398    | 3                  | (852)    | 0                          | 1,845   | 6     | 17       | 0           | 384        | 139    | --          | (30,931)   |
| 1992 | 13,888             | 19,149    | 2,721    | 4,104       | 1,534      | 300                 | 7,866    | 43                 | (271)    | 0                          | 4,572   | 2     | 0        | 0           | 408        | 363    | --          | (55,221)   |
| 1993 | 23,700             | 19,730    | 287      | 2,889       | 896        | 300                 | 0        | 43                 | 0        | --                         | 6,254   | 25    | 0        | --          | 331        | 329    | --          | (54,784)   |
| 1994 | 26,391             | 10,200    | 263      | 2,026       | 834        | 300                 | 0        | 43                 | 0        | 0                          | 10,978  | 106   | 38       | --          | 712        | 68     | --          | (51,959)   |
| 1995 | (23,700)           | (10,200)  | (263)    | (2,026)     | (834)      | (300)               | (0)      | (43)               | (0)      | (0)                        | (9,486) | (102) | (40)     | --          | (1,096)    | (68)   | --          | (48,465)   |

<sup>1</sup> Japanese pole & line landings include fish caught by research vessels. Longline landings for 1952-1960 exclude minor amounts taken by vessels under 20 tons; landings are estimated by multiplying annual number of fish caught by average weight statistics. Pole & line, longline, driftnet, purse seine and other gear data for 1952-1991 from Y. Uozumi, et.al. Pole & line and purse seine data for 1992, 1993 from Y. Warashina, et.al.

<sup>2</sup> Korean longline landings calculated from Y. Gong using the ratio of landings, in numbers, from the north Pacific. Gillnet landings for 1979-1990 are calculated by multiplying the 1991 CPUE (# fish per pok) by effort (# poks) then multiplying by average weight (1991, 1992: 4.13 kg/fish).

<sup>3</sup> U.S. troll boat landings for 1952-1960 include fish caught by bait boats. U.S. troll boat landings for 1984-1988 include gillnet landings. Other gear include landings from Hawaii (mostly longline). Other gear landings for 1979-1986 are raised from data with very low coverage rates.

<sup>4</sup> Data provided by H. Liu.

Table 2. Landings of South Pacific albacore in metric tons by fisheries, 1952-1995. Provisional estimates are given in parentheses.  
 -- indicates data not available. (0) indicates less than 1 metric ton.

| YEAR | JAPAN       |                            | TAIWAN        |               | KOREA     | UNITED STATES      | NEW ZEALAND             | FRENCH POLYNESIA | FIJI      | AUSTRALIA                    | NEW CALEDONIA | TONGA     | OTHER                   | GRAND TOTAL            |
|------|-------------|----------------------------|---------------|---------------|-----------|--------------------|-------------------------|------------------|-----------|------------------------------|---------------|-----------|-------------------------|------------------------|
|      | POLE & LINE | LONG <sup>1</sup> GILL NET | LONG GILL NET | LONG GILL NET | LONG LINE | TROLL <sup>2</sup> | TROLL <sup>3</sup> LINE | LONG TROLL LINE  | LONG LINE | LONG <sup>5</sup> LINE TROLL | LONG LINE     | LONG LINE | TROLL <sup>6</sup> LINE | LONG <sup>7</sup> LINE |
| 1952 |             | 154                        |               |               |           |                    |                         |                  |           |                              |               |           |                         | 154                    |
| 1953 |             | 803                        |               |               |           |                    |                         |                  |           |                              |               |           |                         | 803                    |
| 1954 |             | 9,578                      |               |               |           |                    |                         |                  |           |                              |               |           |                         | 9,578                  |
| 1955 |             | 8,625                      |               |               |           |                    |                         |                  |           |                              |               |           |                         | 8,625                  |
| 1956 |             | 7,281                      |               |               |           |                    |                         |                  |           |                              |               |           |                         | 7,281                  |
| 1957 |             | 8,757                      |               |               | 146       |                    |                         |                  |           |                              |               |           |                         | 8,757                  |
| 1958 |             | 18,490                     |               |               | 456       |                    |                         |                  |           |                              |               |           |                         | 18,636                 |
| 1959 |             | 17,385                     |               |               |           |                    |                         |                  |           |                              |               |           |                         | 17,841                 |
| 1960 | 45          | 21,538                     |               |               | 610       |                    |                         |                  |           |                              |               |           |                         | 22,293                 |
| 1961 |             | 23,412                     |               |               | 330       |                    |                         |                  |           |                              |               |           |                         | 23,742                 |
| 1962 |             | 34,620                     |               |               | 599       |                    |                         |                  |           |                              |               |           |                         | 35,219                 |
| 1963 | 16          | 29,120                     |               |               | 1,367     |                    |                         |                  |           |                              |               |           |                         | 30,503                 |
| 1964 |             | 19,390                     |               |               | 2,911     |                    |                         |                  |           |                              |               |           |                         | 22,301                 |
| 1965 |             | 17,793                     |               |               | 6,405     |                    |                         |                  |           |                              |               |           |                         | 24,198                 |
| 1966 |             | 21,627                     |               |               | 10,817    |                    |                         |                  |           |                              |               |           |                         | 32,444                 |
| 1967 |             | 15,104                     |               | 11,723        | 13,717    |                    | 5                       |                  |           |                              |               |           |                         | 40,549                 |
| 1968 |             | 6,659                      |               | 12,375        | 10,138    |                    | 14                      |                  |           |                              |               |           |                         | 29,186                 |
| 1969 |             | 4,894                      |               | 9,557         | 9,963     |                    | --                      |                  |           |                              |               |           |                         | 24,414                 |
| 1970 |             | 5,297                      |               | 14,682        | 11,599    |                    | 50                      |                  |           |                              |               |           |                         | 31,728                 |
| 1971 |             | 3,472                      |               | 15,880        | 14,482    |                    | --                      | (0)              |           | 100                          |               |           |                         | 33,934                 |
| 1972 |             | 3,027                      |               | 16,780        | 14,439    |                    | 268                     | (0)              |           | 100                          |               |           |                         | 34,614                 |
| 1973 |             | 2,550                      |               | 17,742        | 17,452    |                    | 484                     | (0)              |           | 100                          |               |           |                         | 38,332                 |
| 1974 |             | 1,868                      |               | 17,246        | 12,194    |                    | 898                     | (0)              |           | 100                          |               |           |                         | 32,306                 |
| 1975 |             | 1,333                      |               | 16,939        | 9,015     |                    | 646                     | (0)              |           | 100                          |               |           |                         | 28,033                 |
| 1976 |             | 2,054                      |               | 13,653        | 12,212    |                    | 25                      | (0)              |           | 100                          |               |           |                         | 28,050                 |
| 1977 |             | 2,328                      |               | 21,452        | 13,176    |                    | 621                     | (0)              |           | 100                          |               |           |                         | 37,686                 |
| 1978 |             | 2,845                      |               | 20,935        | 10,989    |                    | 1,686                   | (0)              |           | 100                          |               |           |                         | 36,564                 |
| 1979 |             | 2,274                      |               | 14,952        | 8,682     |                    | 814                     | (0)              |           | 100                          |               |           |                         | 26,843                 |
| 1980 | 19          | 2,216                      |               | 25,579        | 10,852    |                    | 1,468                   | (0)              |           | 100                          |               |           |                         | 40,259                 |
| 1981 | 8           | 4,203                      |               | 14,367        | 14,793    |                    | 2,085                   | (0)              |           | 5                            |               |           |                         | 35,463                 |
| 1982 | 1           | 4,899                      |               | 12,644        | 12,586    |                    | 2,434                   | (0)              |           | 6                            |               |           |                         | 32,684                 |
| 1983 | 2           | 5,723                      | 32            | 12,106        | 6,669     |                    | 744                     | (0)              |           | 7                            |               | 106       |                         | 25,457                 |
| 1984 |             | 3,804                      | 1,581         | 11,155        | 5,730     |                    | 2,773                   | (0)              |           | 8                            |               | 143       |                         | 25,317                 |
| 1985 |             | 3,868                      | 1,928         | 9,601         | 14,267    |                    | 3,253                   | (0)              |           | 9                            |               | 135       |                         | 33,243                 |
| 1986 |             | 4,426                      | 1,936         | 11,913        | 18,799    | 89                 | 1,911                   | (0)              |           | 10                           |               | 174       |                         | 39,509                 |
| 1987 |             | 4,490                      | 919           | 15,009        | 8,646     | 751                | 1,227                   | (0)              |           | 11                           |               | 206       |                         | 31,999                 |
| 1988 |             | 7,469                      | 4,271         | 17,120        | 5,600     | 3,253              | 330                     | (0)              |           | 12                           |               | 252       | 140                     | 40,128                 |
| 1989 |             | 5,839                      | 13,263        | 10,867        | 3,997     | 3,068              | 5,161                   | 90               | 100       | 93                           | 566           | 195       | 162                     | 52,130                 |

Table 2. (continued)

| YEAR | JAPAN       |                        | TAIWAN   |           | KOREA    |           | UNITED STATES | NEW ZEALAND        |                    | FRENCH POLYNESIA       |       | FIJI      | AUSTRALIA              |       | NEW CALEDONIA |           | TONGA     | OTHER              |                        | GRAND TOTAL |
|------|-------------|------------------------|----------|-----------|----------|-----------|---------------|--------------------|--------------------|------------------------|-------|-----------|------------------------|-------|---------------|-----------|-----------|--------------------|------------------------|-------------|
|      | POLE & LINE | LONG <sup>1</sup> LINE | GILL NET | LONG LINE | GILL NET | LONG LINE | GILL NET      | TROLL <sup>2</sup> | TROLL <sup>3</sup> | LONG <sup>4</sup> LINE | TROLL | LONG LINE | LONG <sup>5</sup> LINE | TROLL | LONG LINE     | LONG LINE | LONG LINE | TROLL <sup>6</sup> | LONG <sup>7</sup> LINE |             |
| 1990 |             | 6,574                  | 5,667    | 9,689     | 1,859    | 2,586     | 3,898         | 2,525              | 249                | 327                    | 156   | 263       | 125                    | 15    | 1,053         | 152       |           | --                 |                        | 35,138      |
| 1991 |             | 4,468                  |          | 11,235    | 821      | 1,225     | 5,540         | 2,464              | 325                | 326                    | 146   | 416       | 170                    | 20    | 909           | 174       |           | 103                |                        | 28,342      |
| 1992 | 49          | 3,914                  |          | 18,989    |          | 1,556     | 3,016         | 3,856              | 706                | 72                     | 174   | 310       | 207                    | 70    | 520           | 199       |           | 0                  |                        | 33,638      |
| 1993 | 5           | 8,384                  |          | 12,986    |          | 2,600     | 1,028         | 3,856              | 539                | 45                     | 714   | 463       | 185                    | 55    | 755           | 232       |           | 0                  | 1                      | 31,848      |
| 1994 |             | 8,147                  |          | 13,802    |          | 1,283     | 530           | 4,400              | 245                | 0                      | 913   | 562       | 355                    | 70    | 840           | 599       |           | --                 |                        | 31,793      |
| 1995 | --          | (8,147)                |          | (15,201)  |          | (1,283)   | 2,319         | (6,000)            | (245)              | 184                    | (121) | (562)     | (355)                  | (25)  | (840)         | (599)     |           | (0)                |                        | (35,881)    |

All data are from SPAR 6, March 1996, except as noted.

<sup>1</sup> Japanese Longline landings include landings from Australian-Japanese joint venture landings.

<sup>2</sup> United States landings are listed for seasons which may include landings from December of previous year.

<sup>3</sup> New Zealand Troll data for 1967 to 1973 from SPAR4, working paper 11, November 1991.

<sup>4</sup> New Zealand Longline landings for 1989 from SPAR4 Report, November 1991.

<sup>5</sup> Australian Longline landings include only domestic landings, not joint venture landings.

<sup>6</sup> Other Troll includes Canada and Fiji.

<sup>7</sup> Other Longline includes Solomon Islands and Peoples Republic of China.

Table 3. Fishery statistics for the 1994 and 1995 U.S.\* North Pacific albacore troll fisheries.

| FISHING SEASON | NO. OF VESSEL TRIPS |         | METRIC TONS LANDED |         | NO. FISH LANDED |                    | AVG FORK LENGTH (cm) | TOTAL DAYS OF EFFORT | CPUE (fish/day) | SAMPLING COVERAGE RATE |                  |
|----------------|---------------------|---------|--------------------|---------|-----------------|--------------------|----------------------|----------------------|-----------------|------------------------|------------------|
|                | TOTAL               | SAMPLED | TOTAL              | SAMPLED | TOTAL           | SAMPLED (MEASURED) |                      |                      |                 | LOGBOOK                | LENGTH-FREQUENCY |
| 1994           | 2,348               | 409     | 10,978             | 4,603   | 1,493,916       | 18,533             | 71                   | 21,489               | 70              | 42%                    | 1.2%             |
| 1995           | 907                 | 348     | 9,486              | 4,963   | 1,413,039       | 24,350             | 69                   | 28,560               | 49              | 52%                    | 1.7%             |

\* Includes some foreign-registered vessels (Tonga, Canada, and Cook Islands) and vessels of unknown registry for logbook sampling coverage rate.

Table 4. Fishery statistics for the 1993-94 and 1994-95 U.S.\* South Pacific albacore troll fisheries.

| FISHING SEASON | NO. OF VESSEL TRIPS |         | METRIC TONS LANDED |         | NO. FISH LANDED |                    | AVG FORK LENGTH (cm) | TOTAL DAYS OF EFFORT | CPUE (fish/day) | SAMPLING COVERAGE RATE |                  |
|----------------|---------------------|---------|--------------------|---------|-----------------|--------------------|----------------------|----------------------|-----------------|------------------------|------------------|
|                | TOTAL               | SAMPLED | TOTAL              | SAMPLED | TOTAL           | SAMPLED (MEASURED) |                      |                      |                 | LOGBOOK                | LENGTH-FREQUENCY |
| 1993-94        | 17                  | 7       | 530                | 278     | 89,880          | 996                | 66                   | 916                  | 98              | 52%                    | 1.1%             |
| 1994-95        | 47                  | 22      | 2,319              | 1,223   | 329,785         | 1,460              | 70                   | 1,941                | 170             | 53%                    | 0.4%             |

\* Includes some vessels of unknown registry for logbook sampling coverage rate.

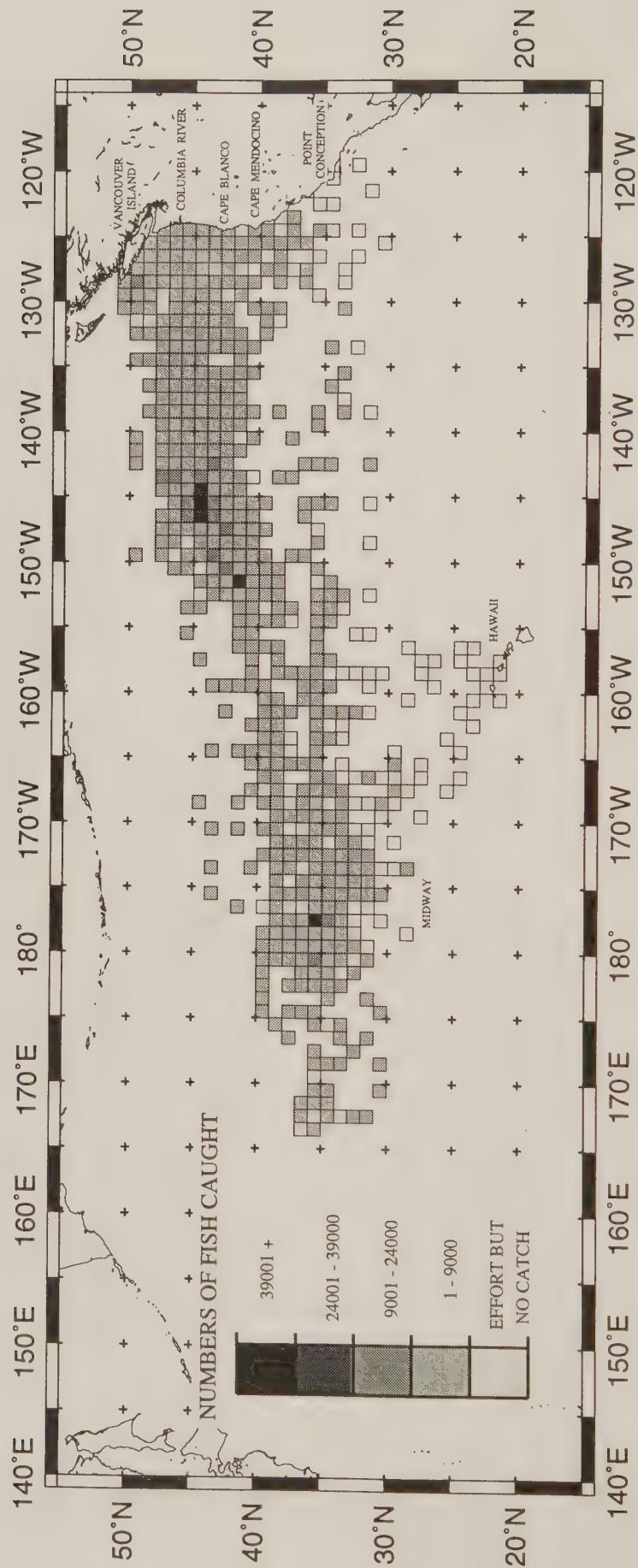


Figure 1a. Catches of albacore in the North Pacific for the 1995 season.

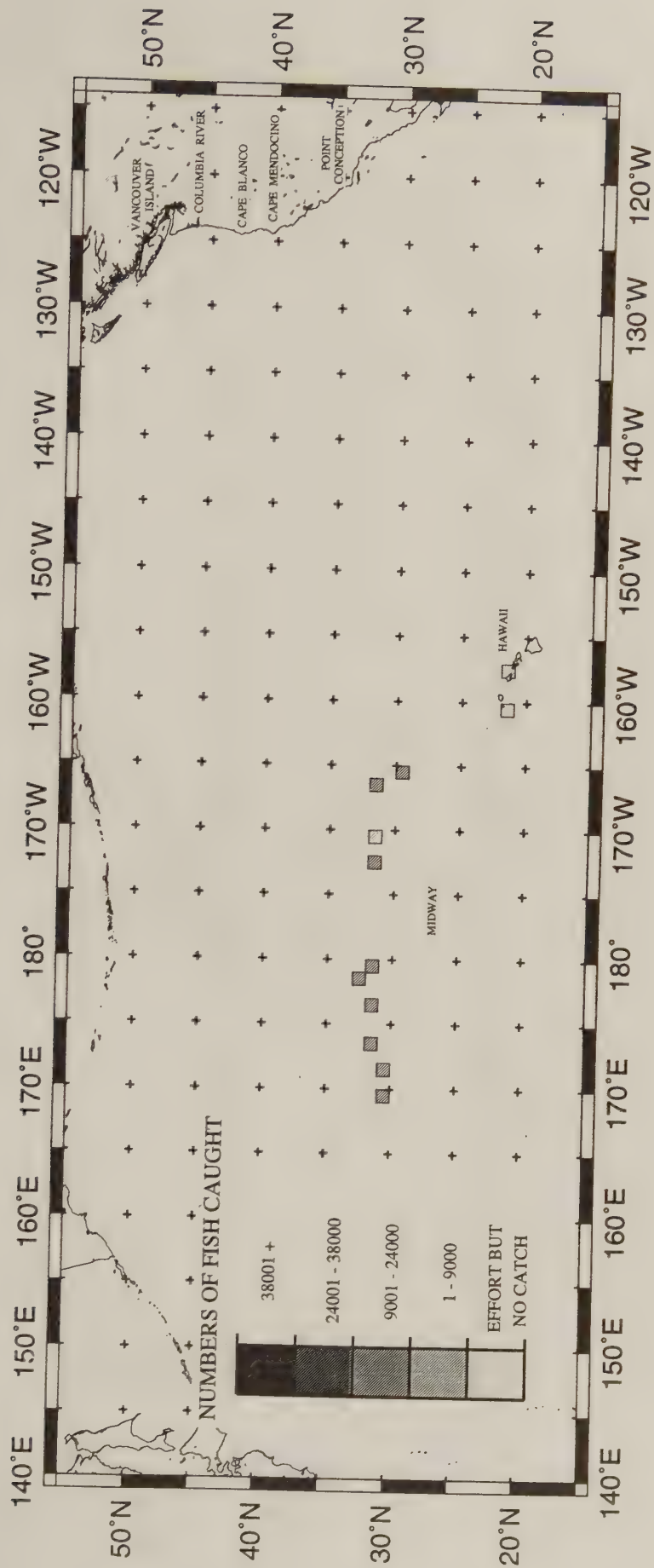


Figure 1b. Catches of albacore in the North Pacific for April 1995.

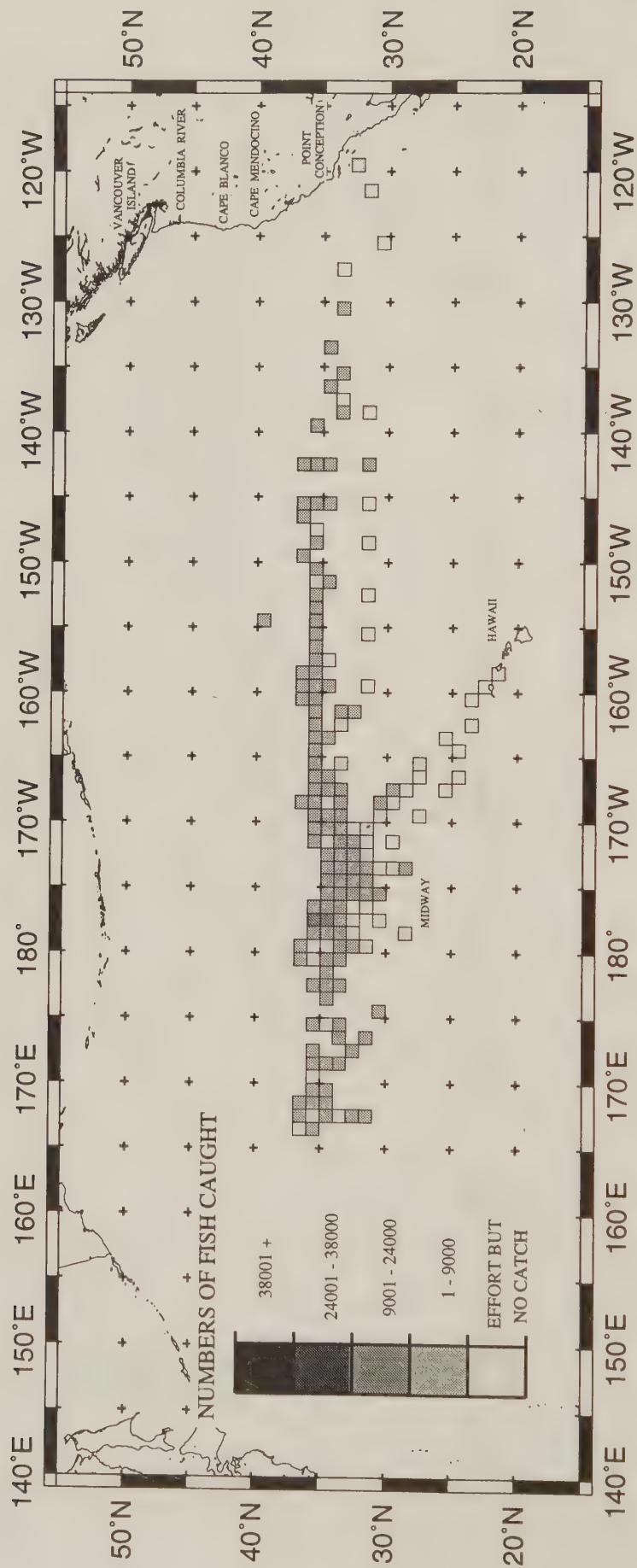


Figure 1c. Catches of albacore in the North Pacific for May 1995.

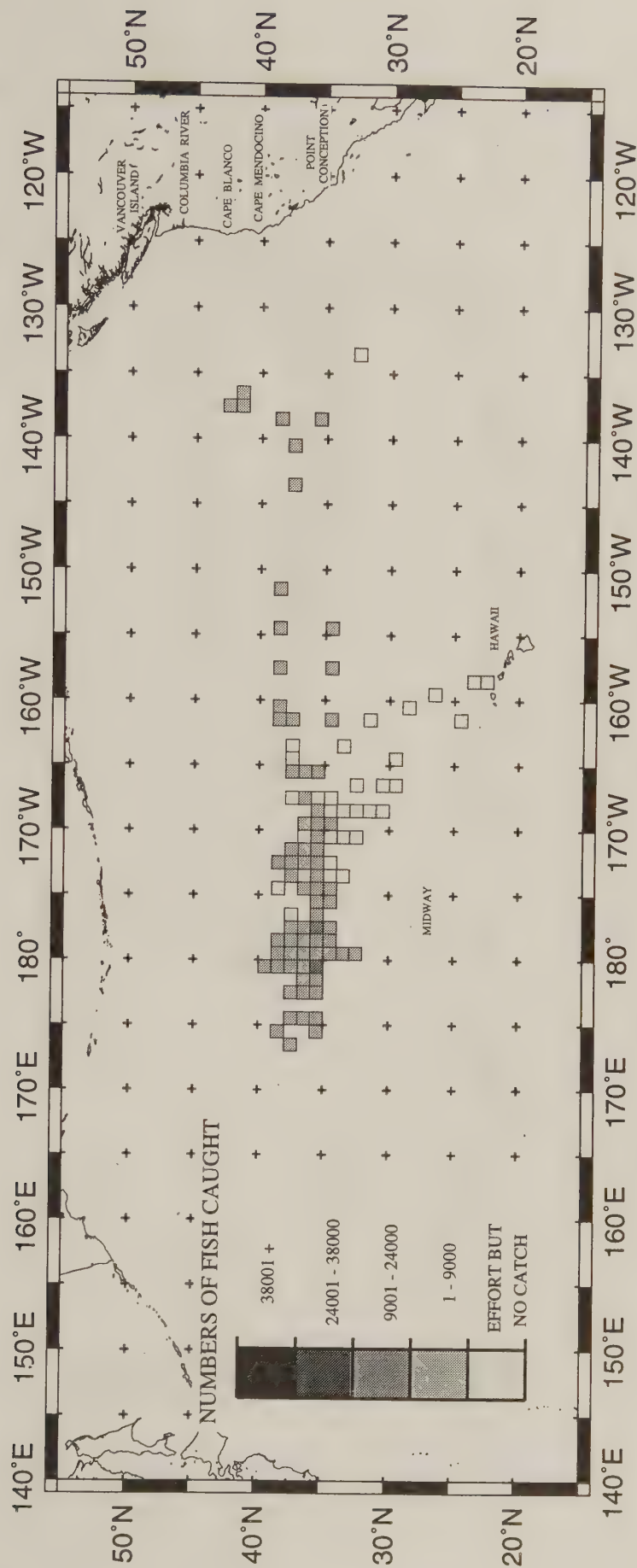


Figure 1d. Catches of albacore in the North Pacific for June 1995.

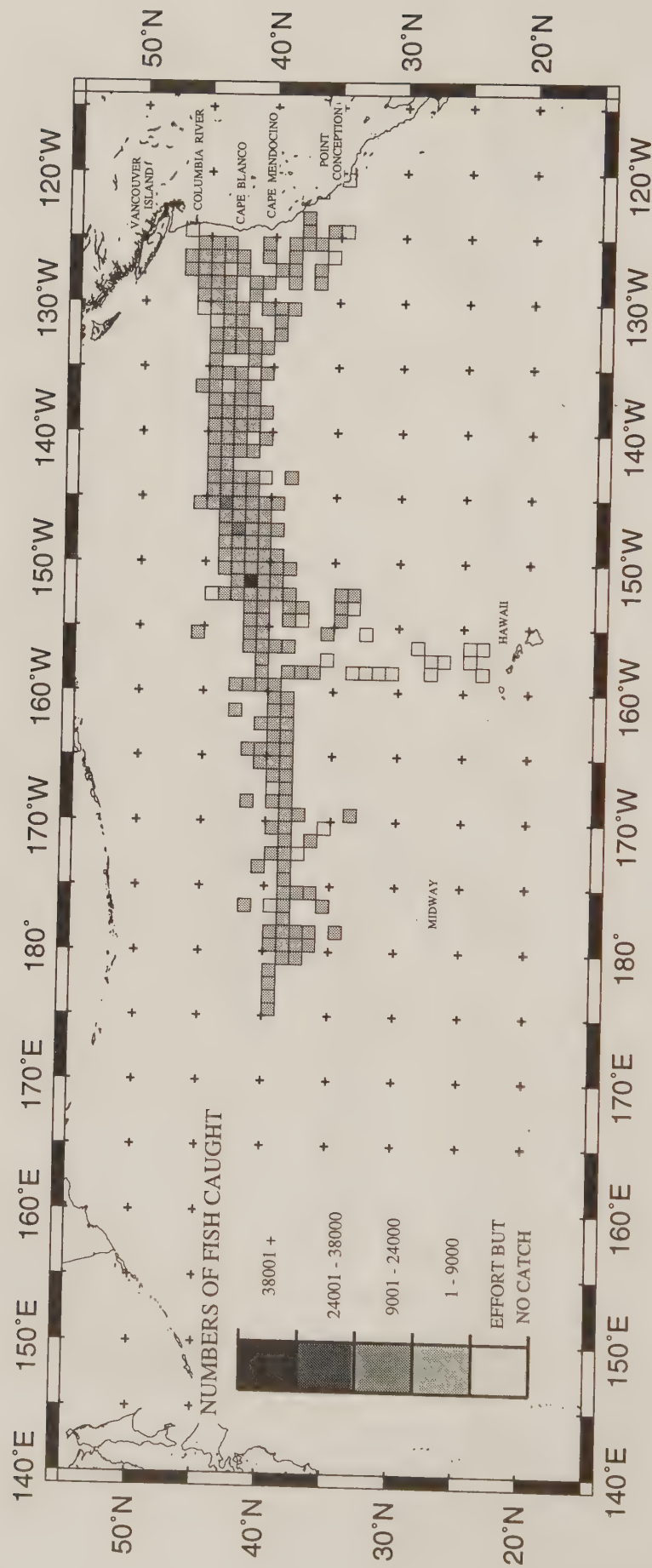


Figure 1e. Catches of albacore in the North Pacific for July 1995.

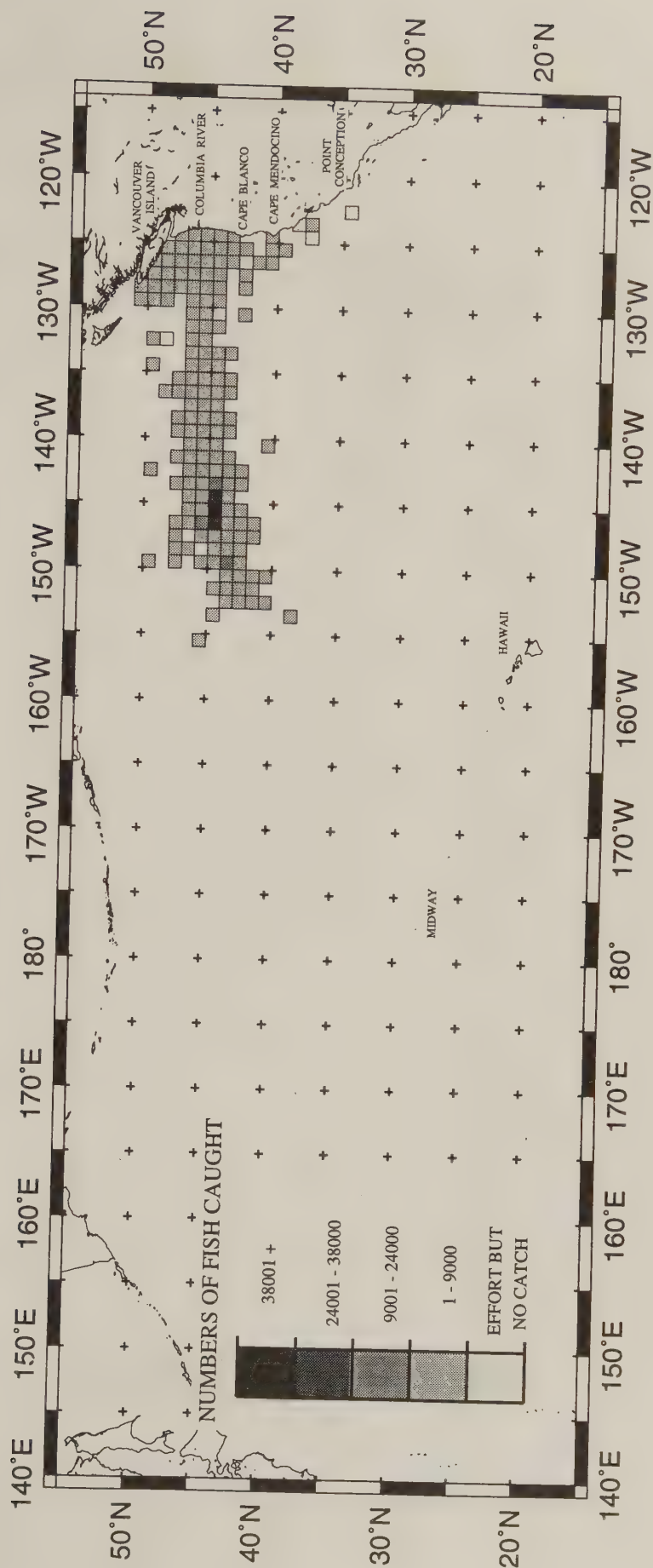


Figure 1f. Catches of albacore in the North Pacific for August 1995.

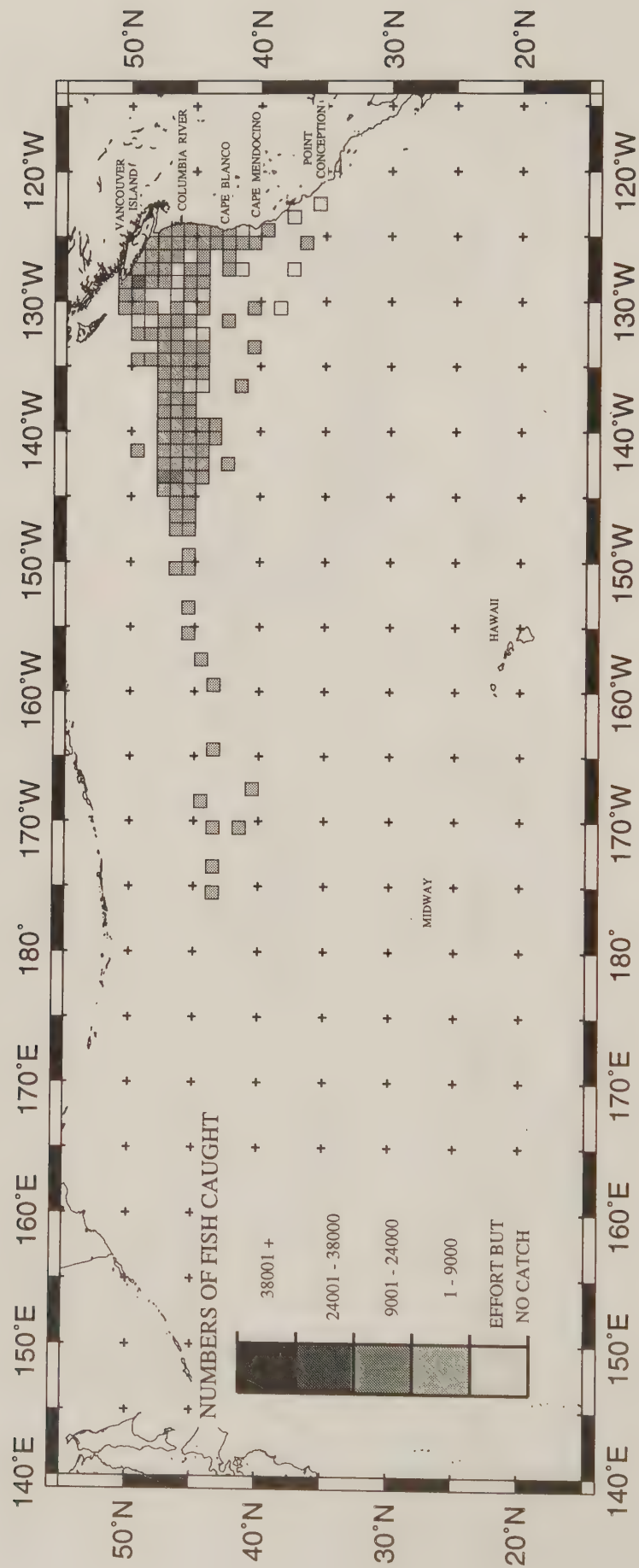


Figure 1g. Catches of albacore in the North Pacific for September 1995.

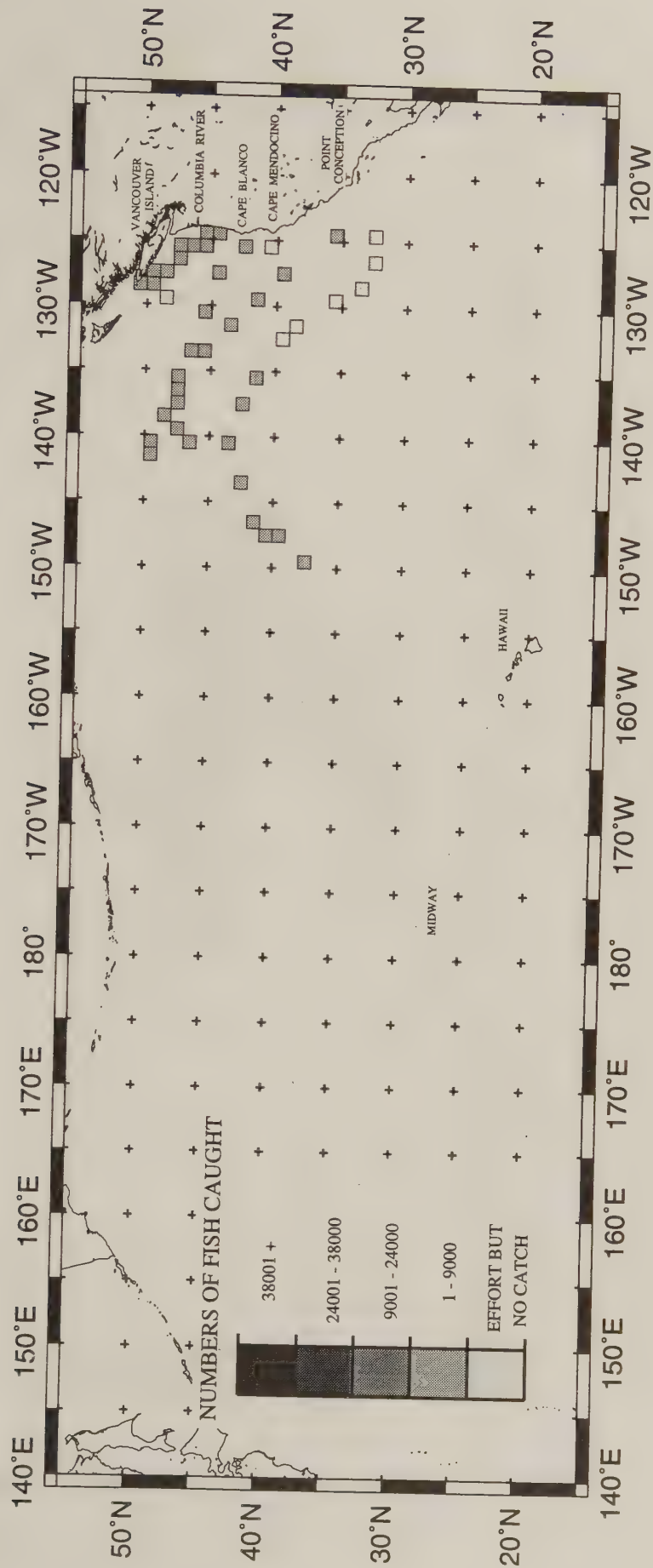


Figure 1h. Catches of albacore in the North Pacific for October 1995.

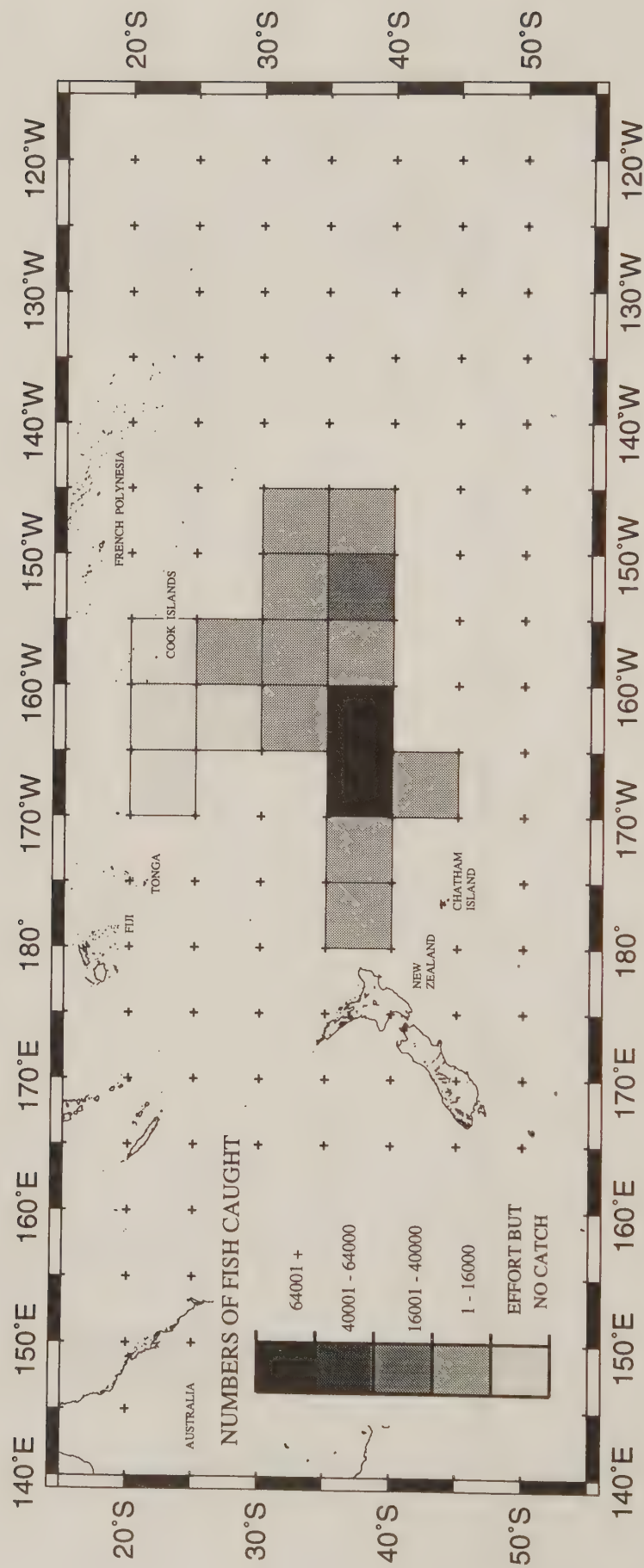


Figure 2a. Catches of albacore in the South Pacific for the 1994-95 season.

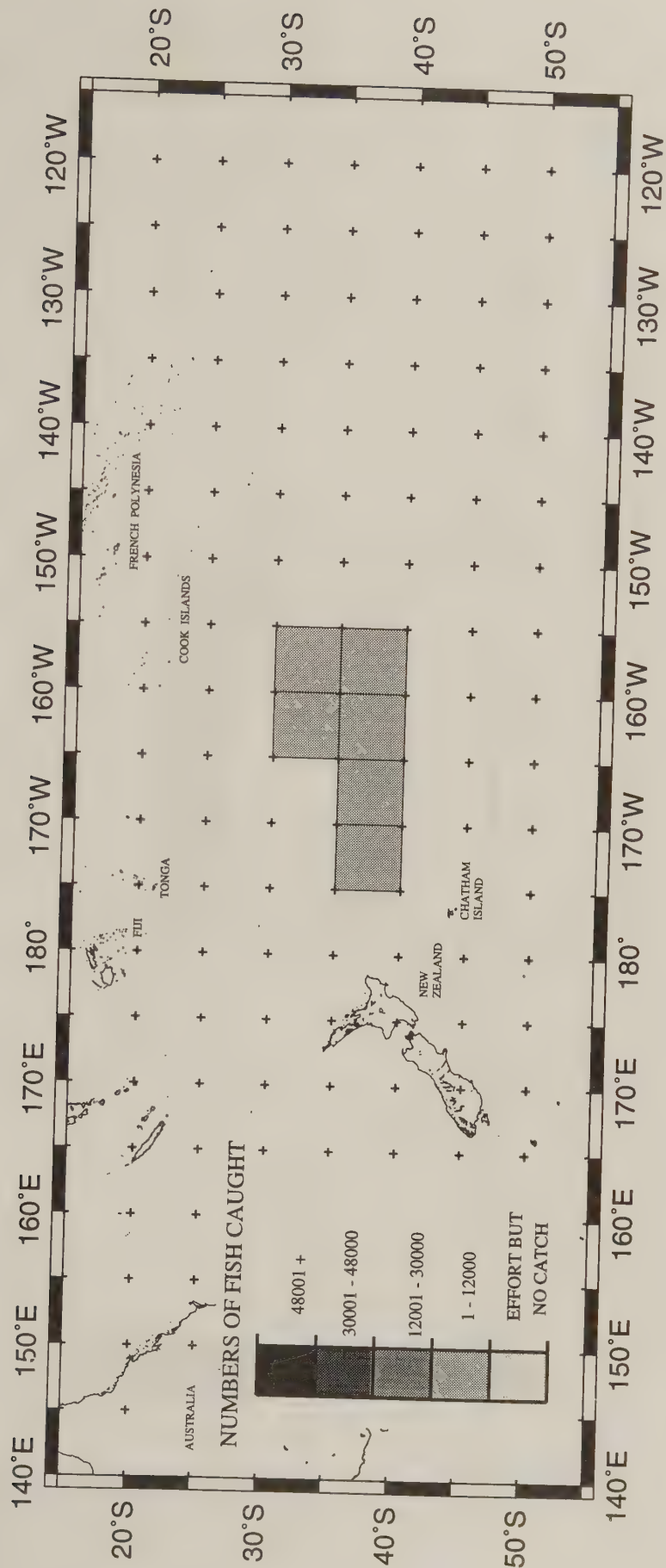


Figure 2b. Catches of albacore in the South Pacific for December 1994.

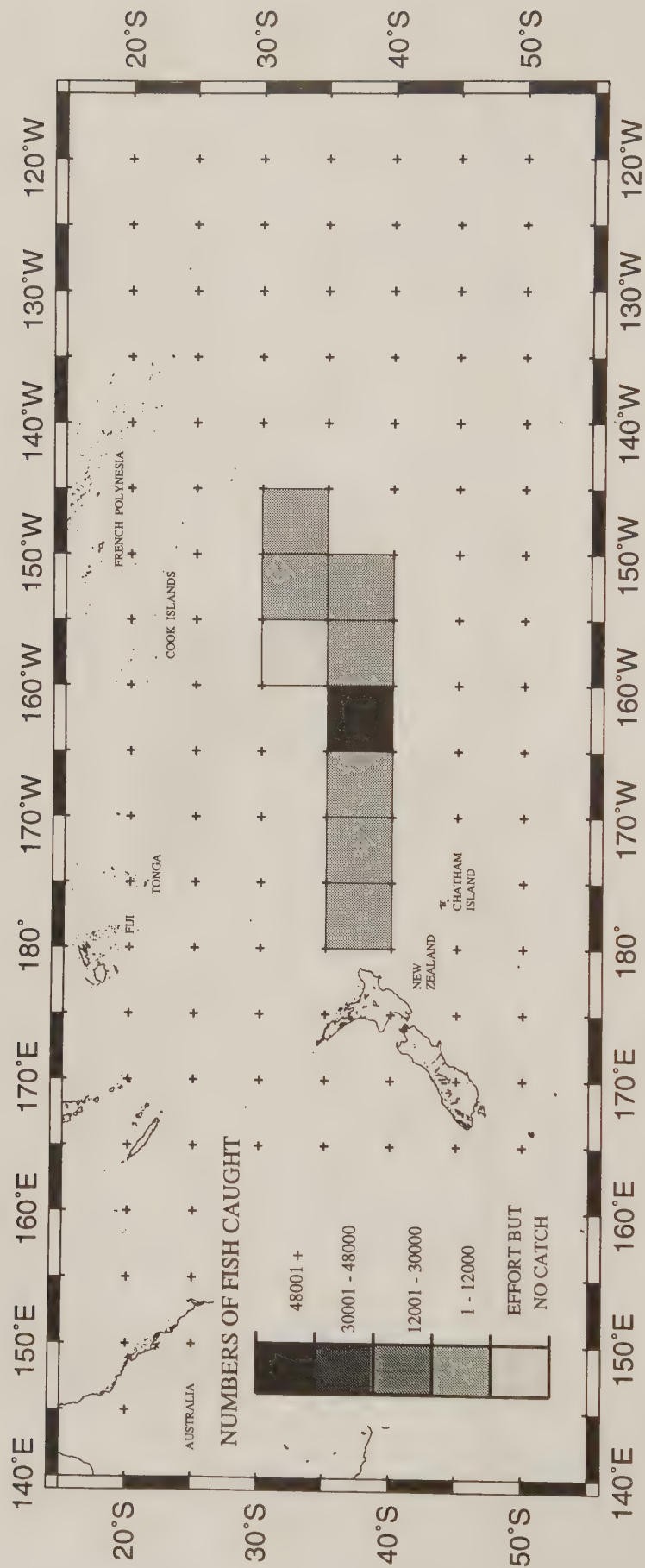


Figure 2c. Catches of albacore in the South Pacific for January 1995.

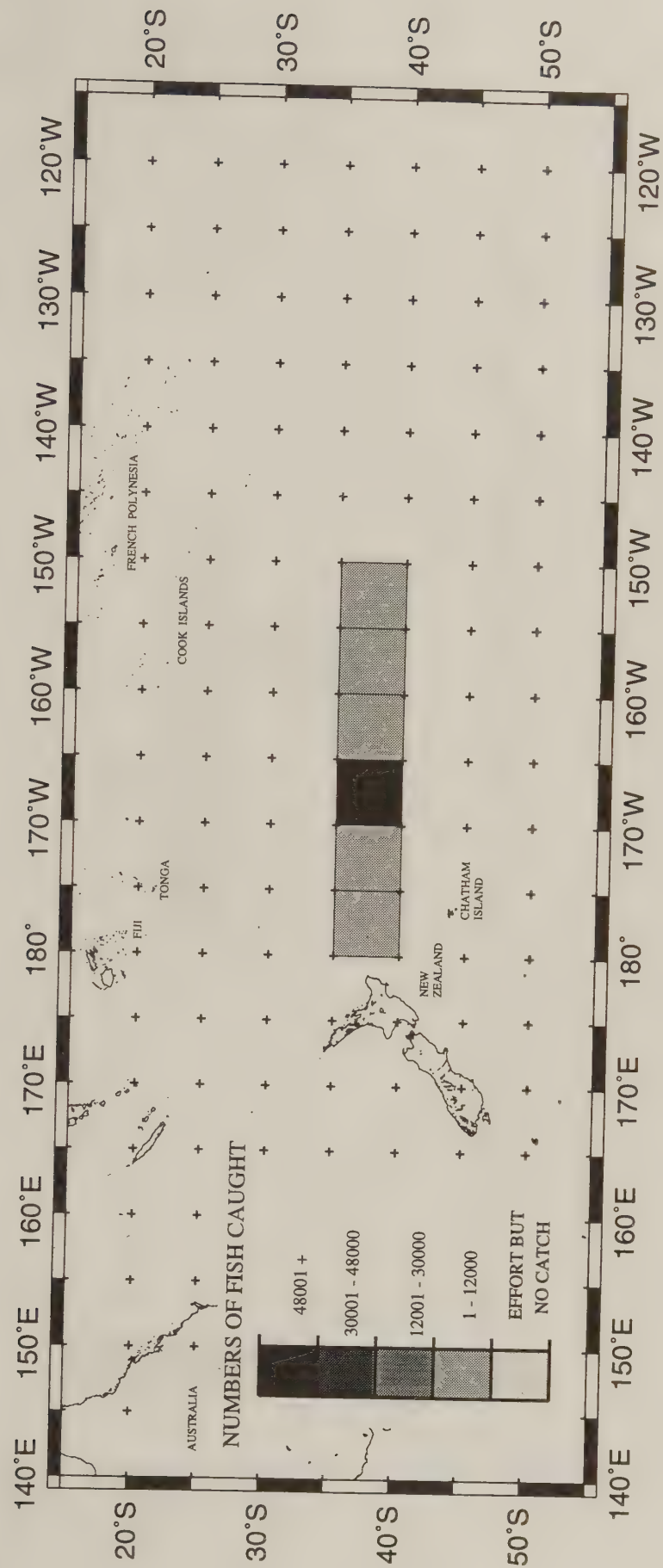


Figure 2d. Catches of albacore in the South Pacific for February 1995.

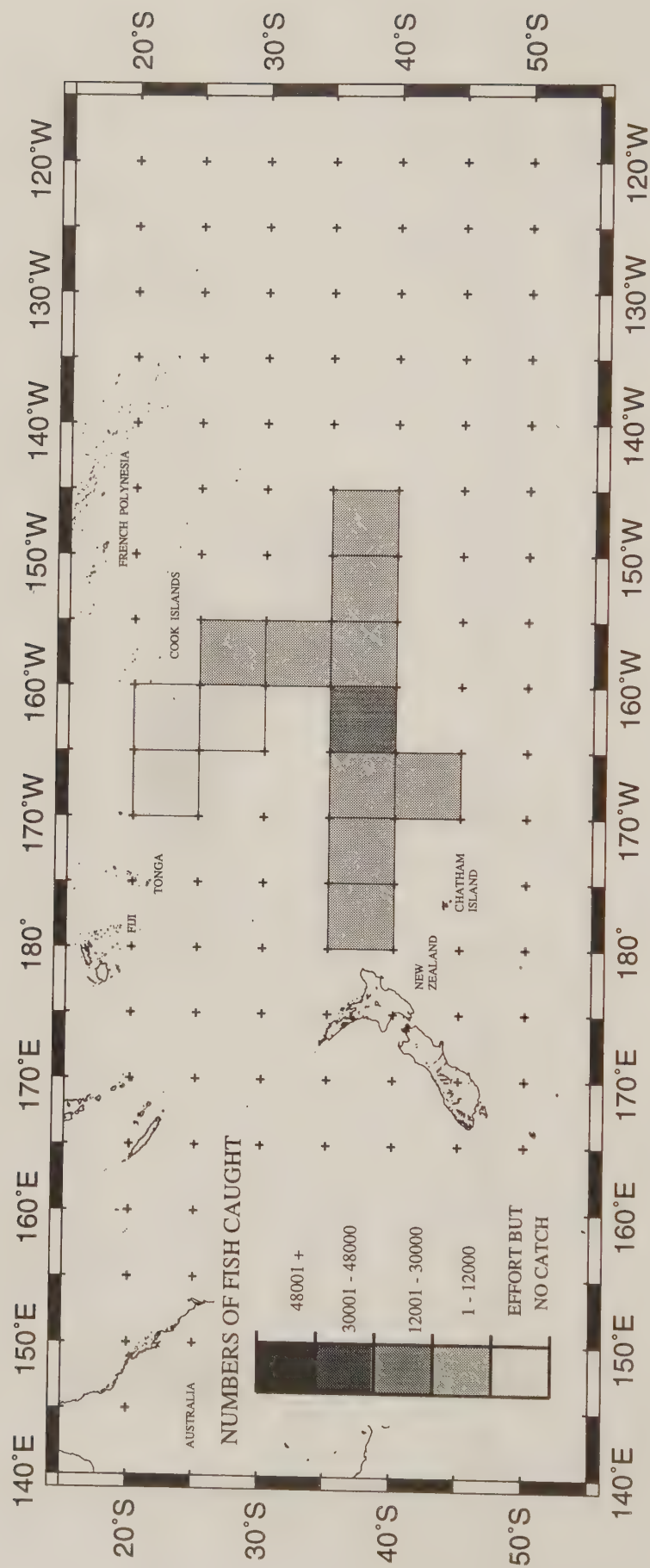


Figure 2e. Catches of albacore in the South Pacific for March 1995.

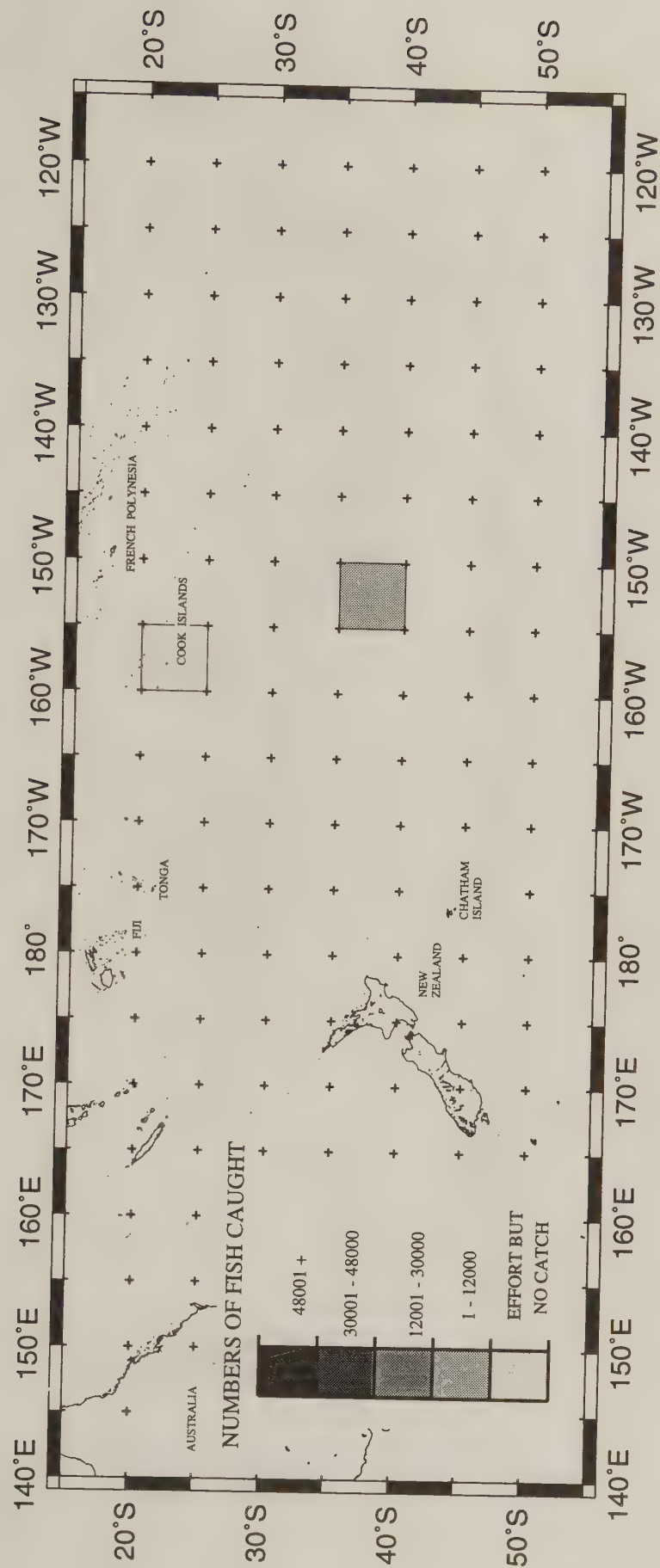


Figure 2f. Catches of albacore in the South Pacific for April 1995.

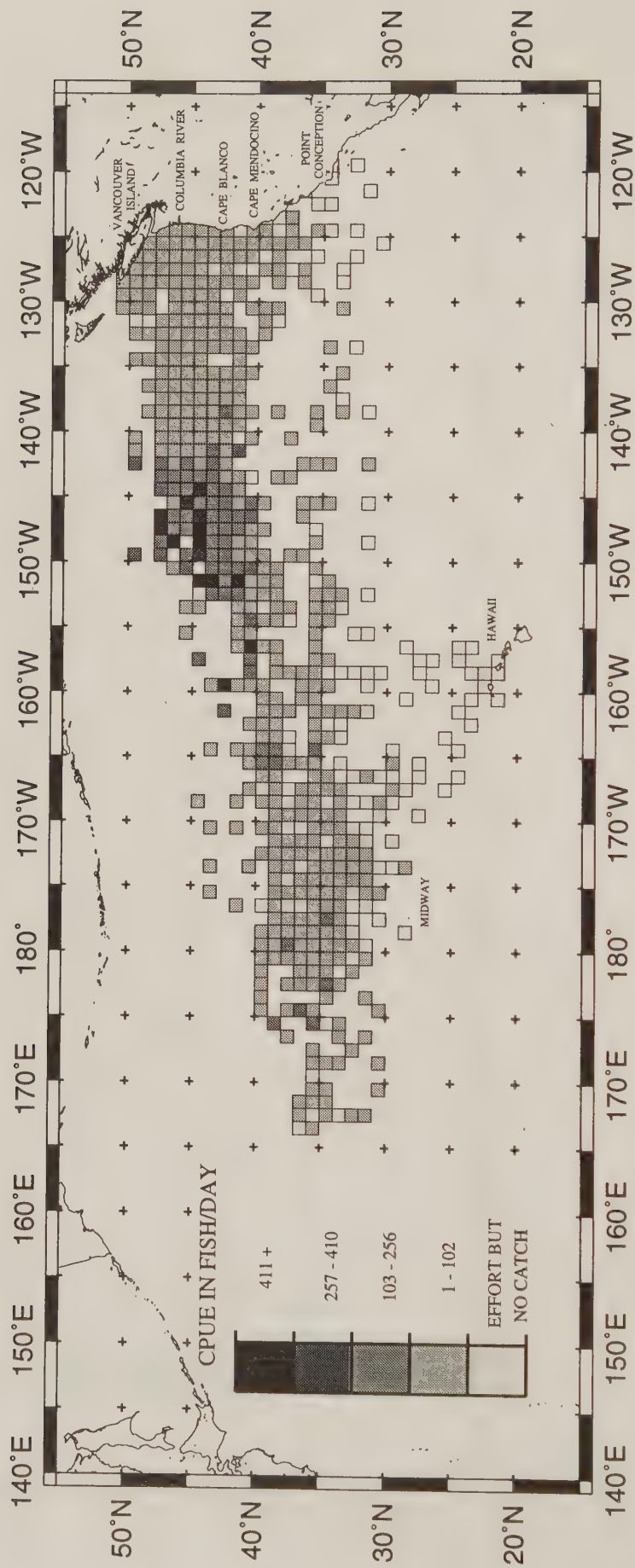


Figure 3a. Albacore CPUE's in the North Pacific for the 1995 season.

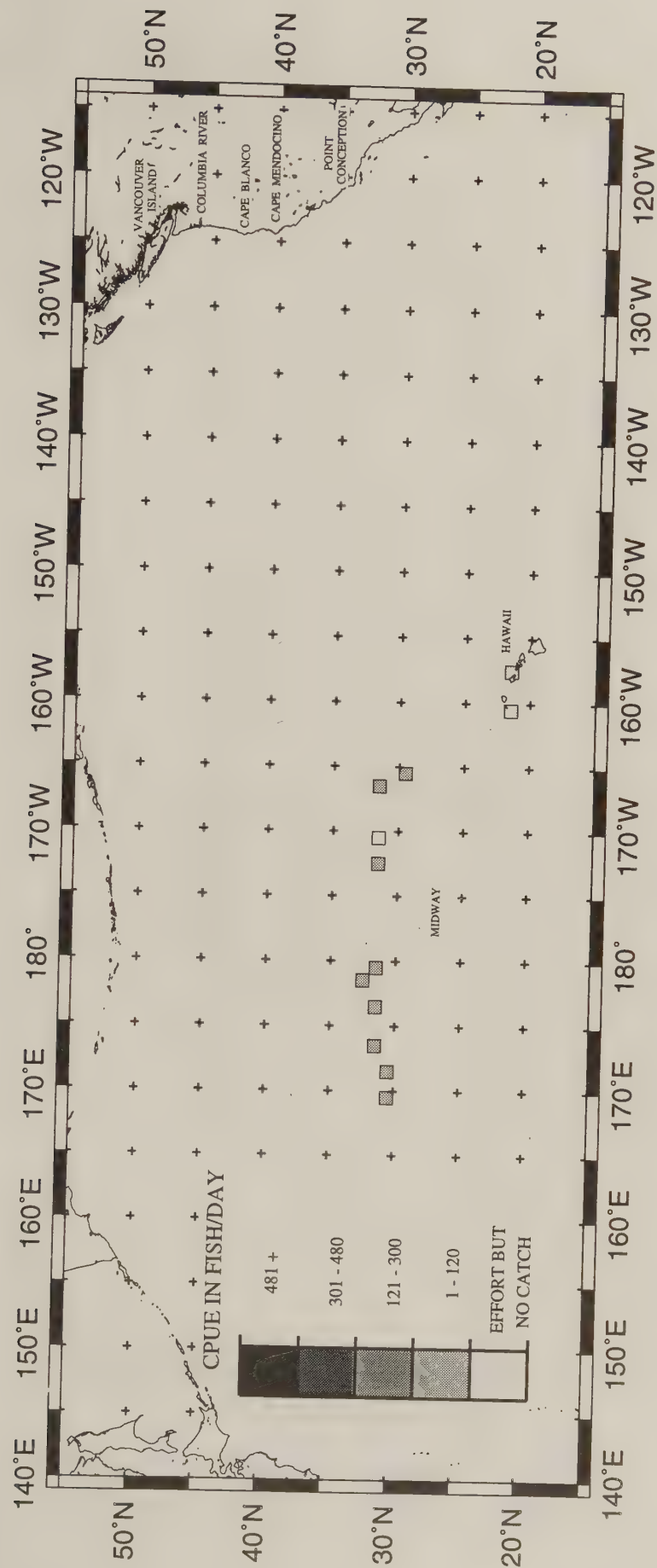


Figure 3b. Albacore CPUE's in the North Pacific for April 1995.

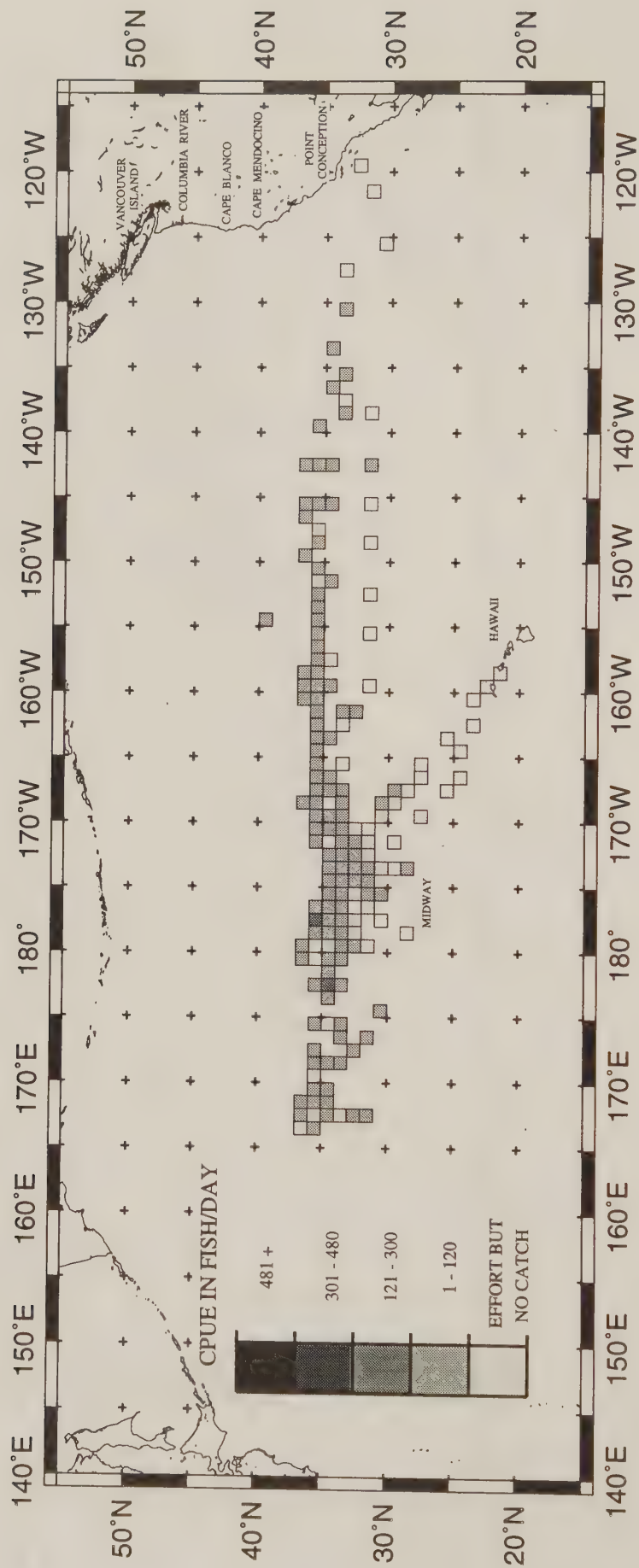


Figure 3c. Albacore CPUE's in the North Pacific for May 1995.

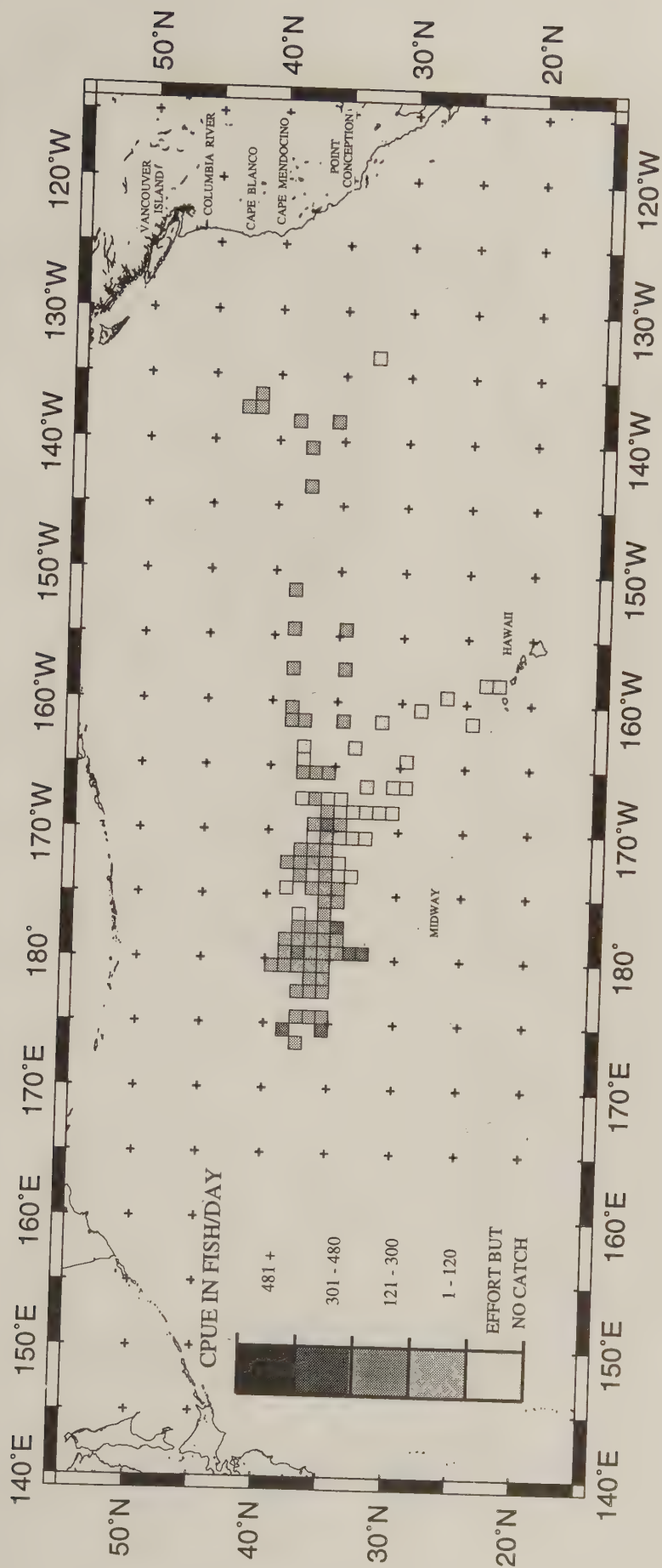


Figure 3d. Albacore CPUE's in the North Pacific for June 1995.

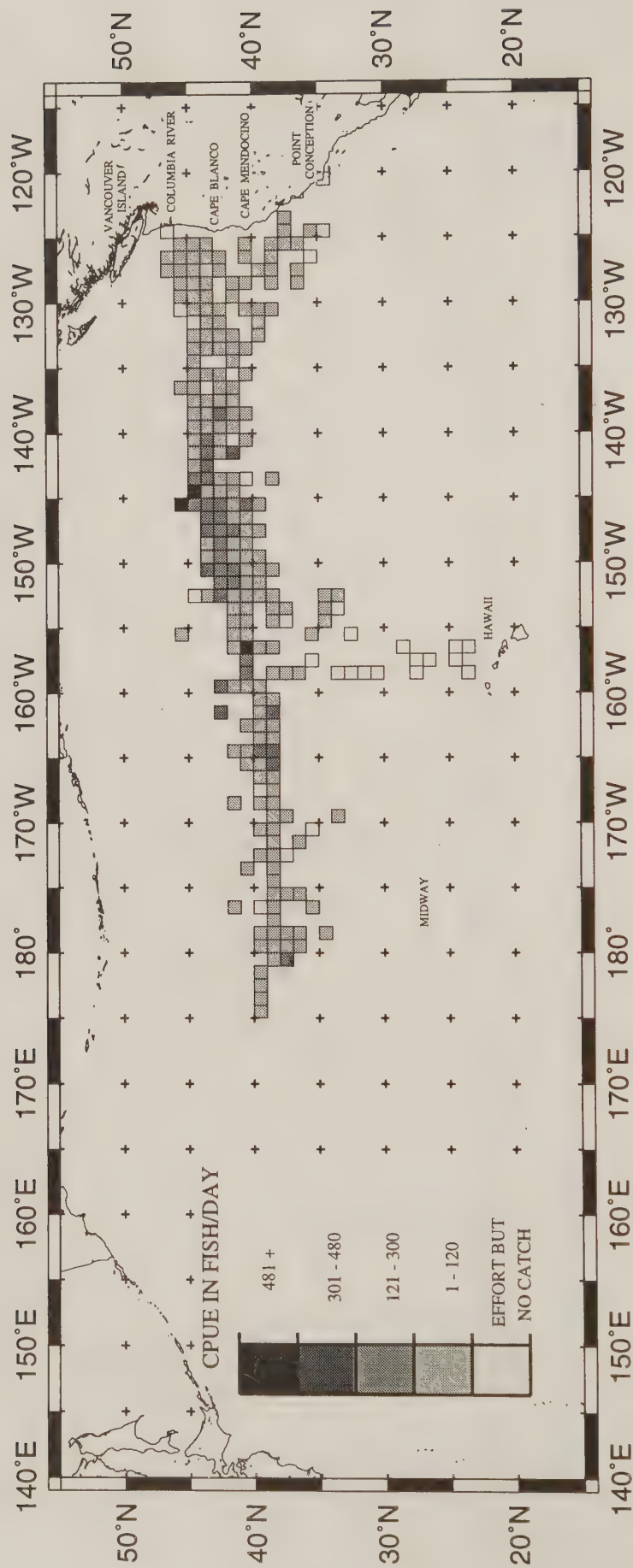


Figure 3e. Albacore CPUE's in the North Pacific for July 1995.

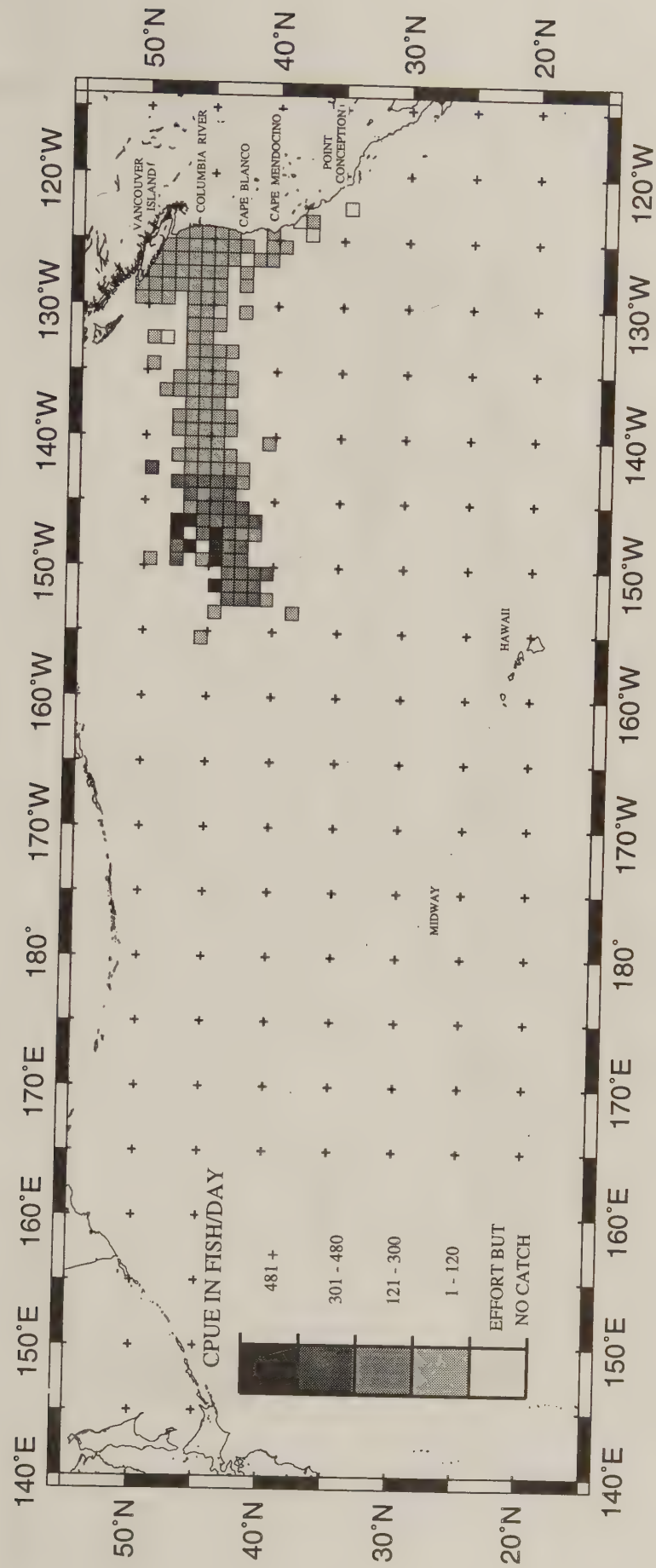


Figure 3f. Albacore CPUE's in the North Pacific for August 1995.

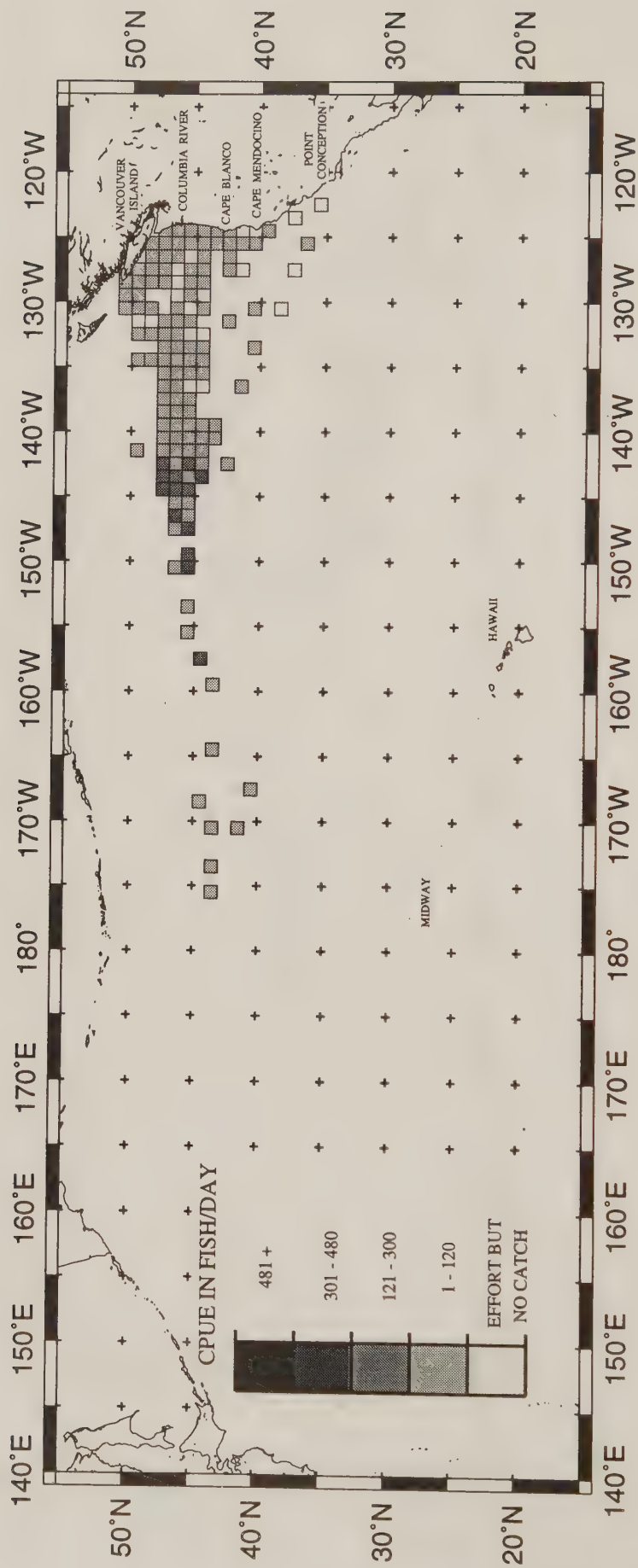


Figure 3g. Albacore CPUE's in the North Pacific for September 1995.

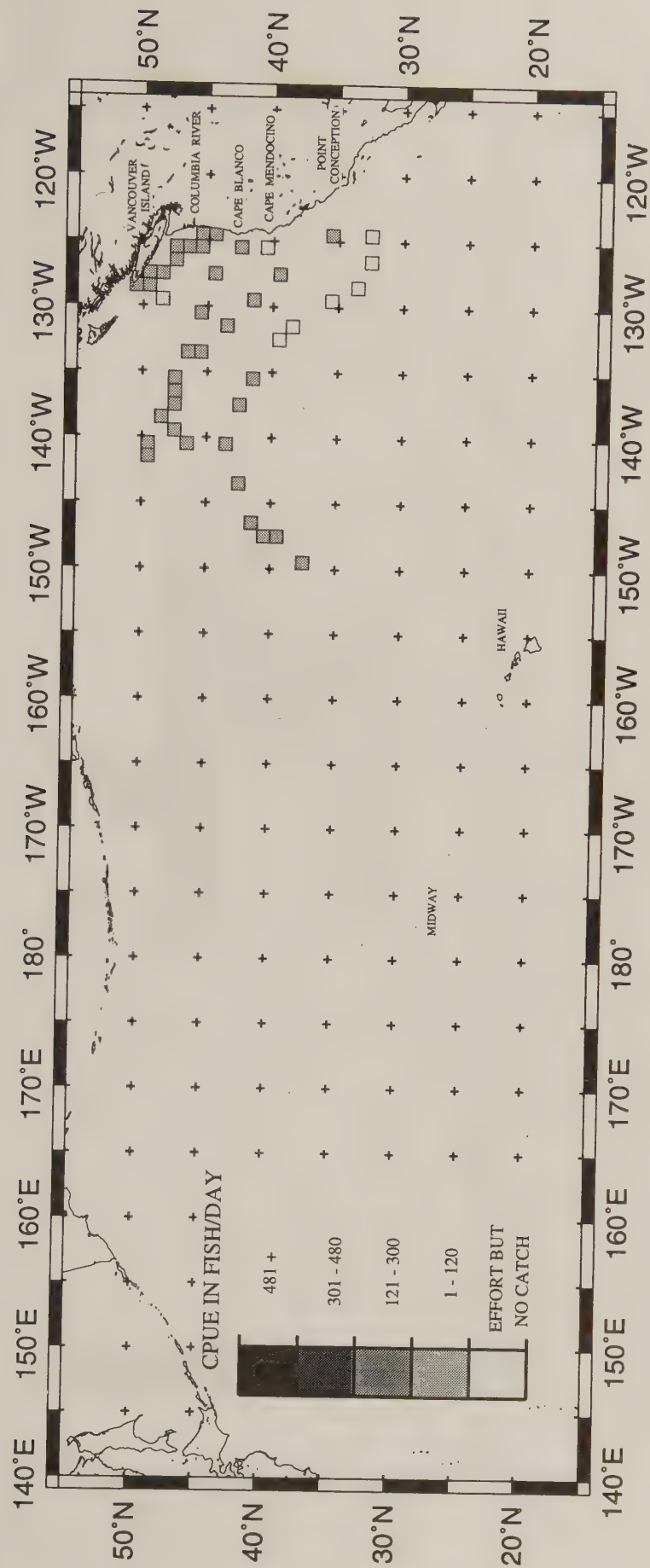


Figure 3h. Albacore CPUE's in the North Pacific for October 1995.



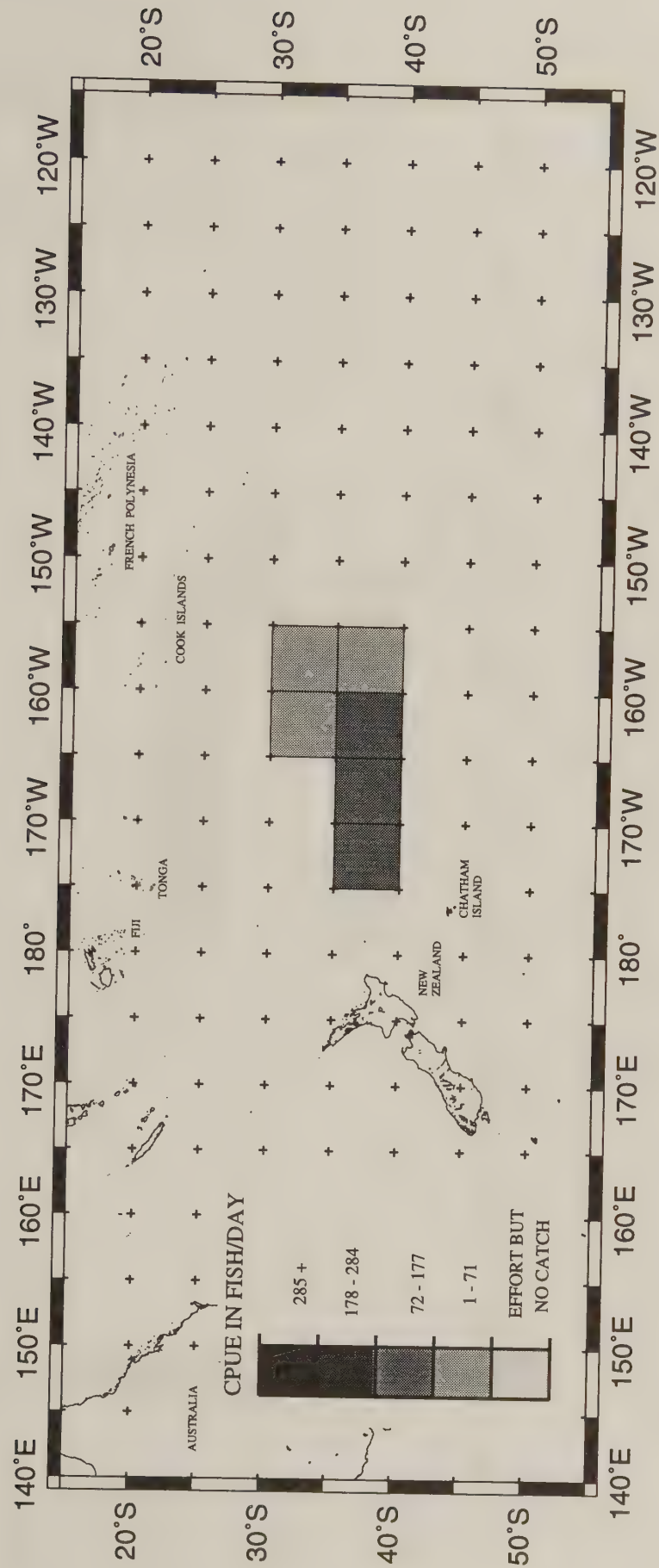


Figure 4b. Albacore CPUE's in the South Pacific for December 1994.

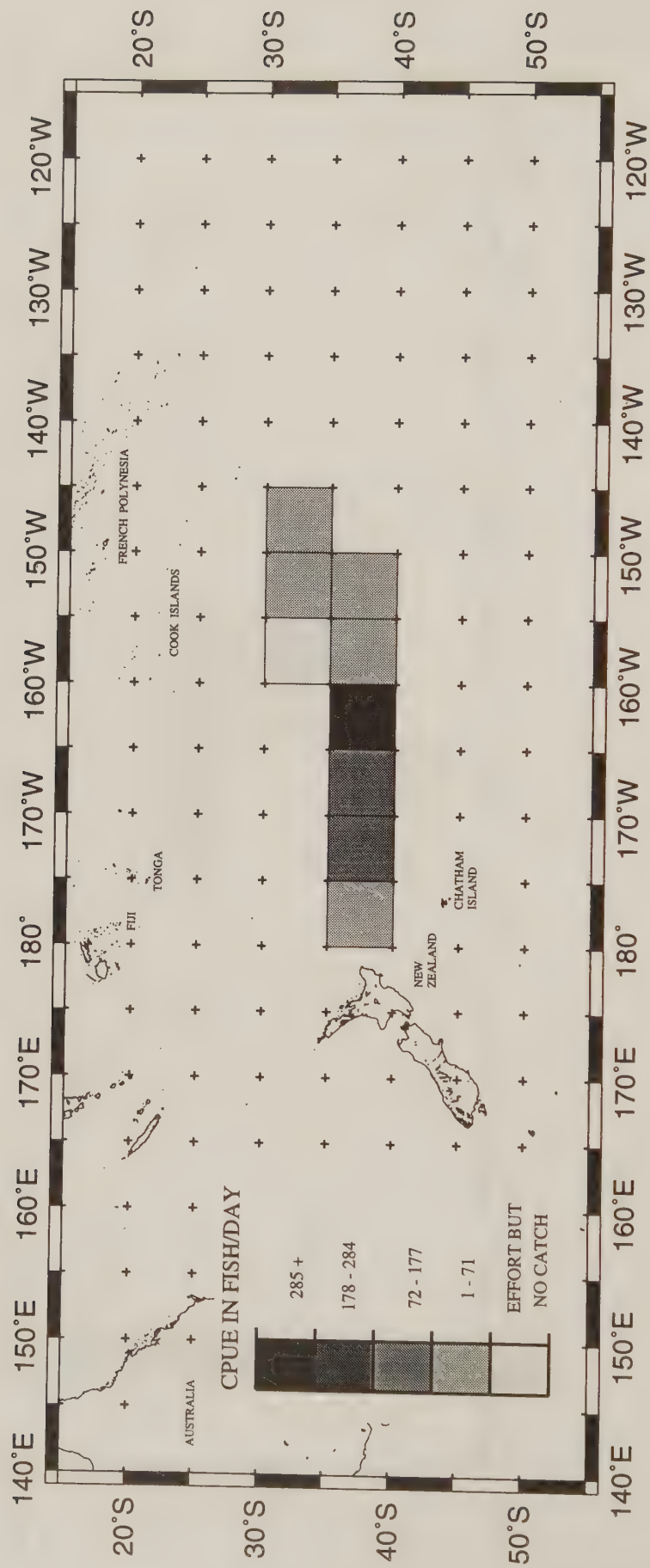


Figure 4c. Albacore CPUE's in the South Pacific for January 1995.

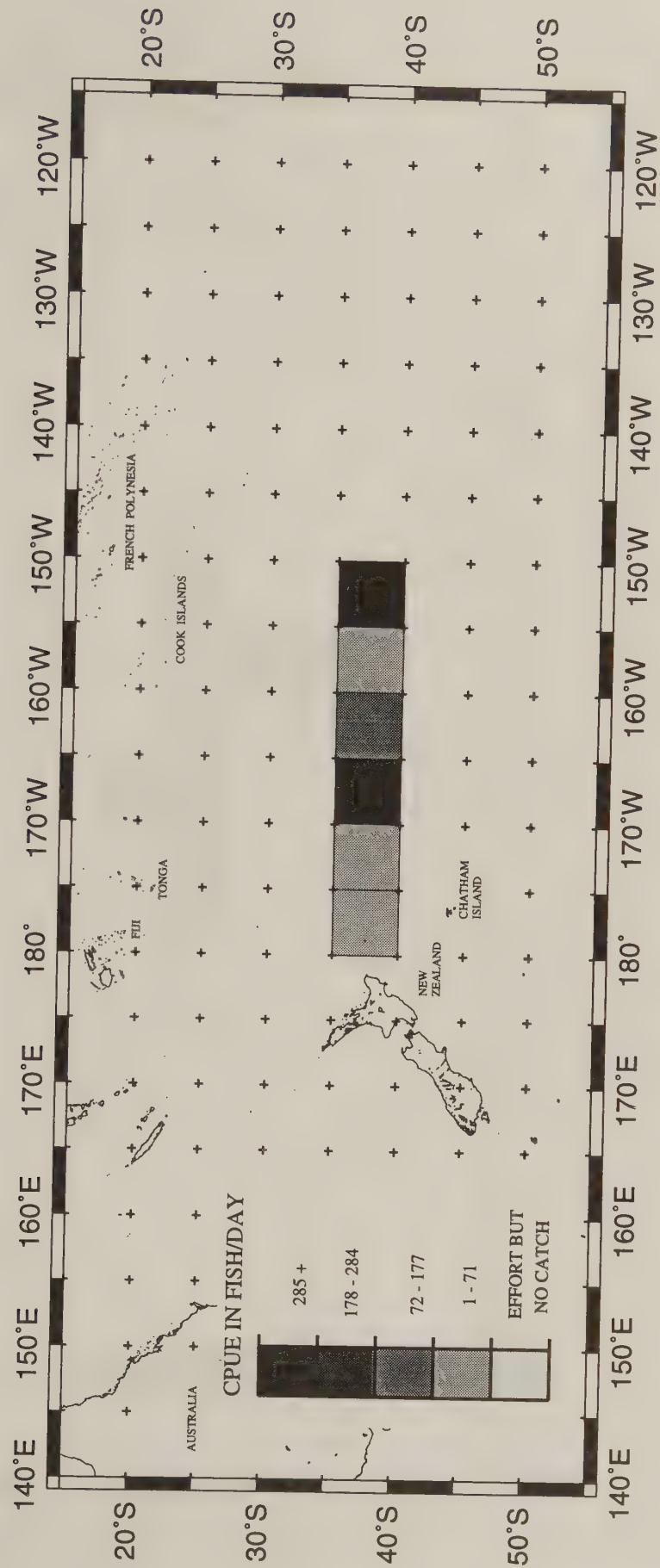


Figure 4d. Albacore CPUE's in the South Pacific for February 1995.

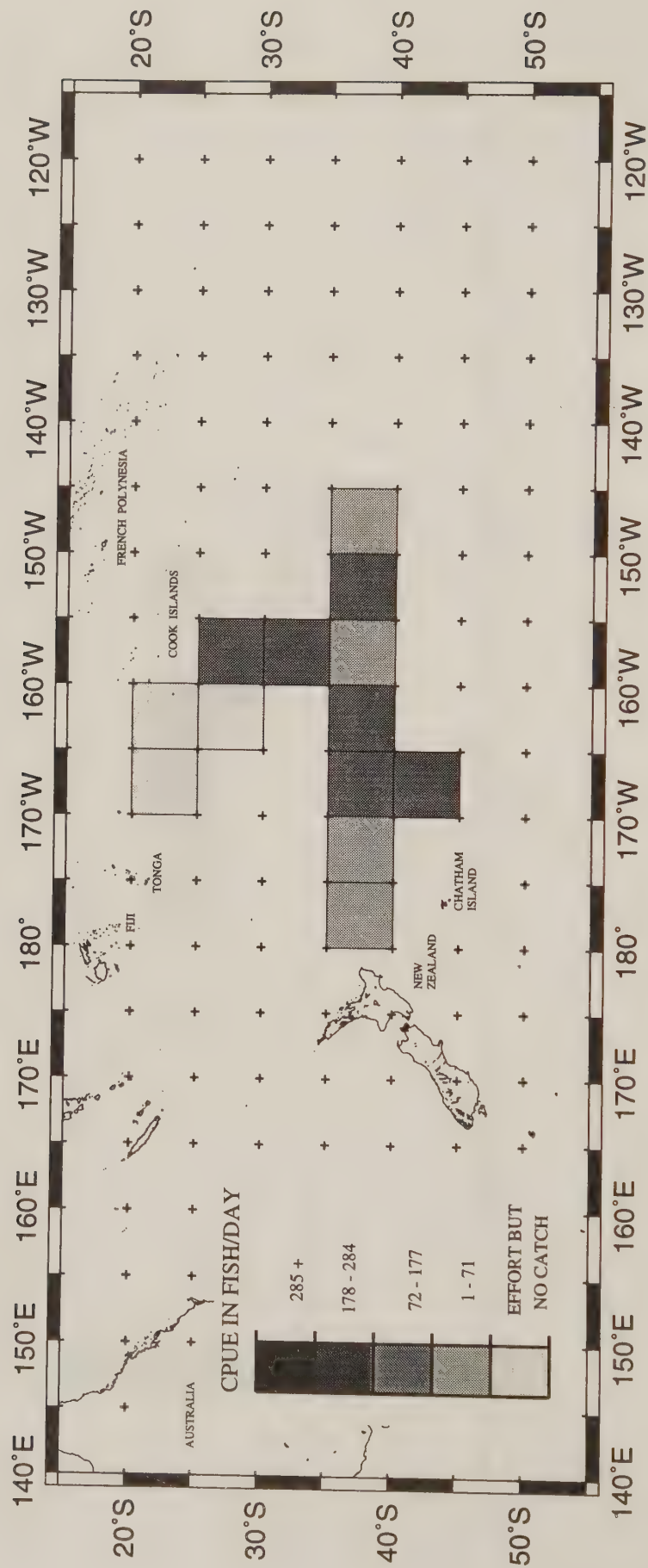


Figure 4e. Albacore CPUE's in the South Pacific for March 1995.

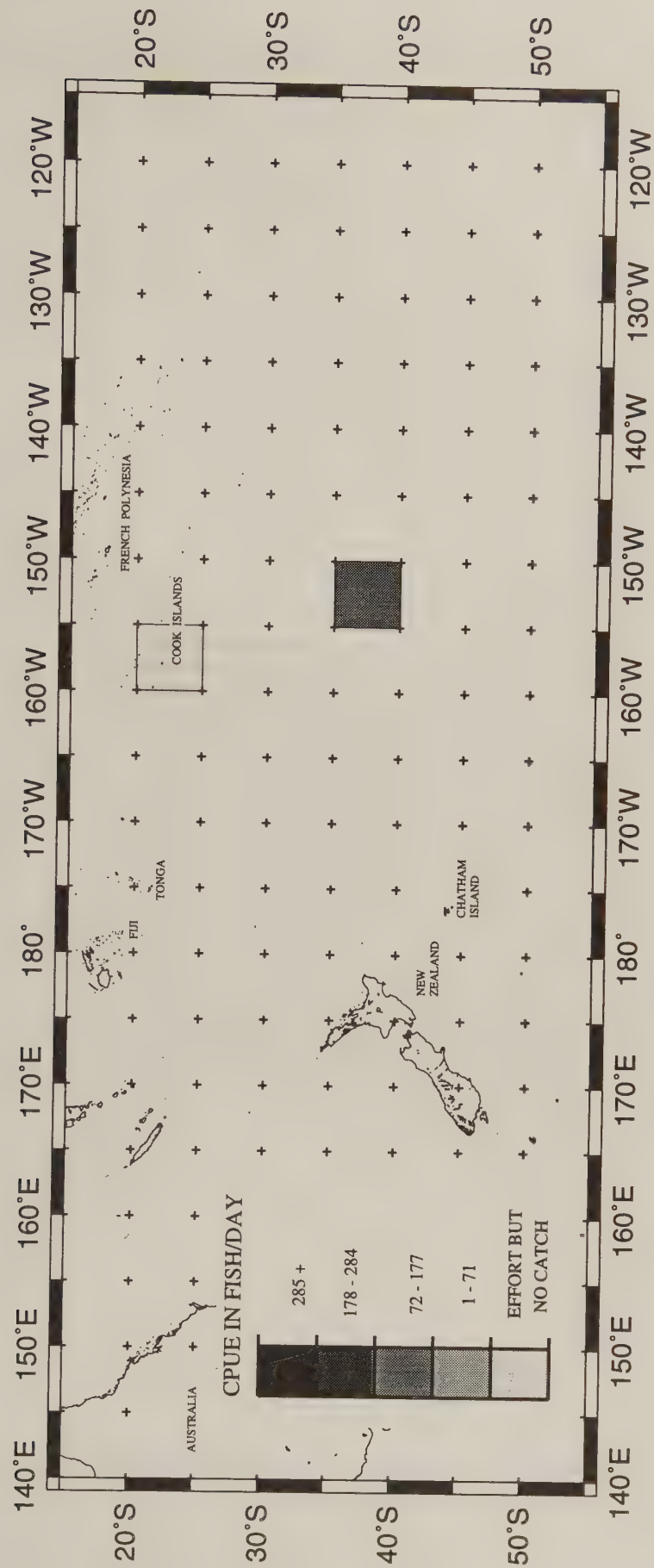


Figure 4f. Albacore CPUE's in the South Pacific for April 1995.

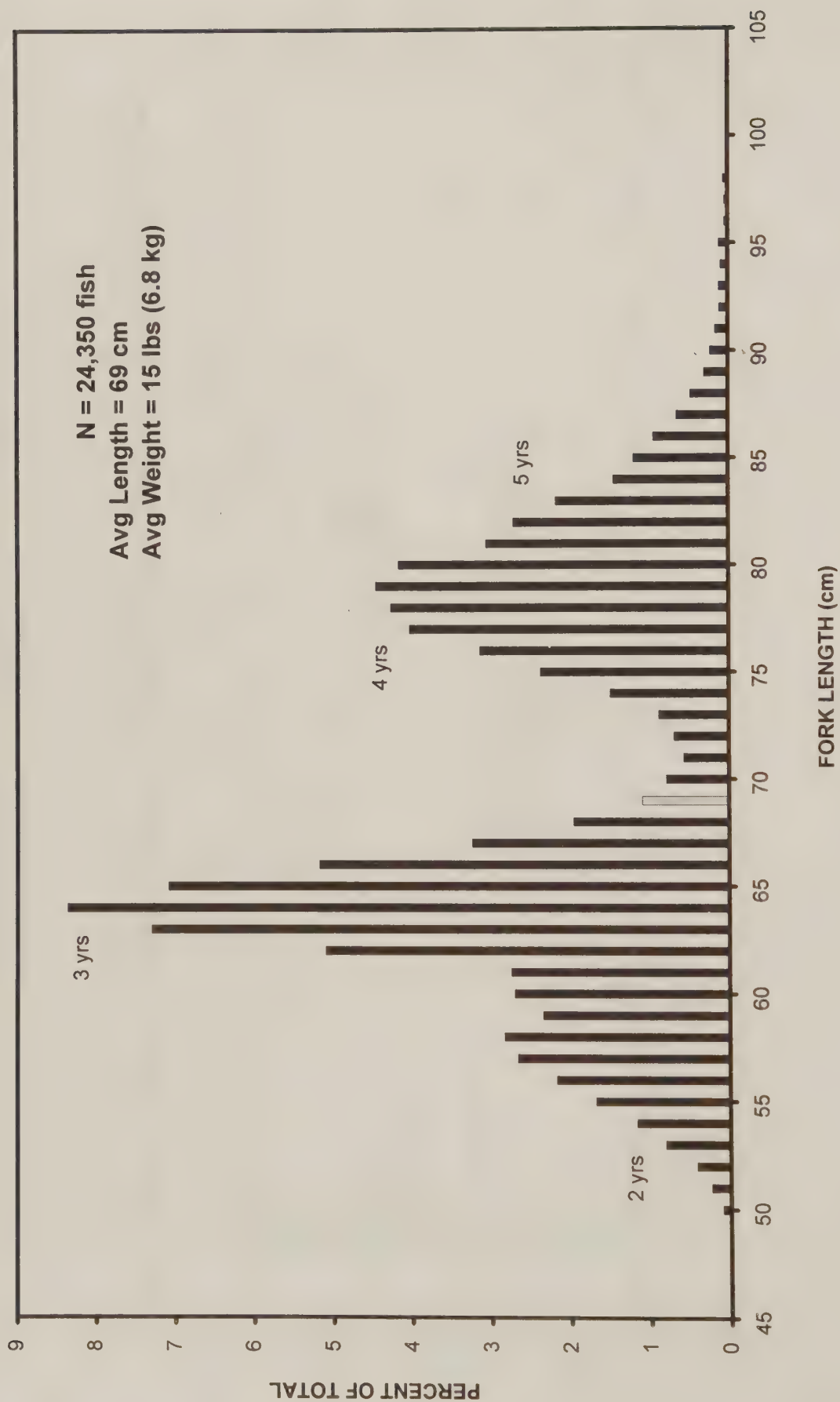


Figure 5. Length-frequencies of albacore sampled from the 1995 North Pacific troll fishery.

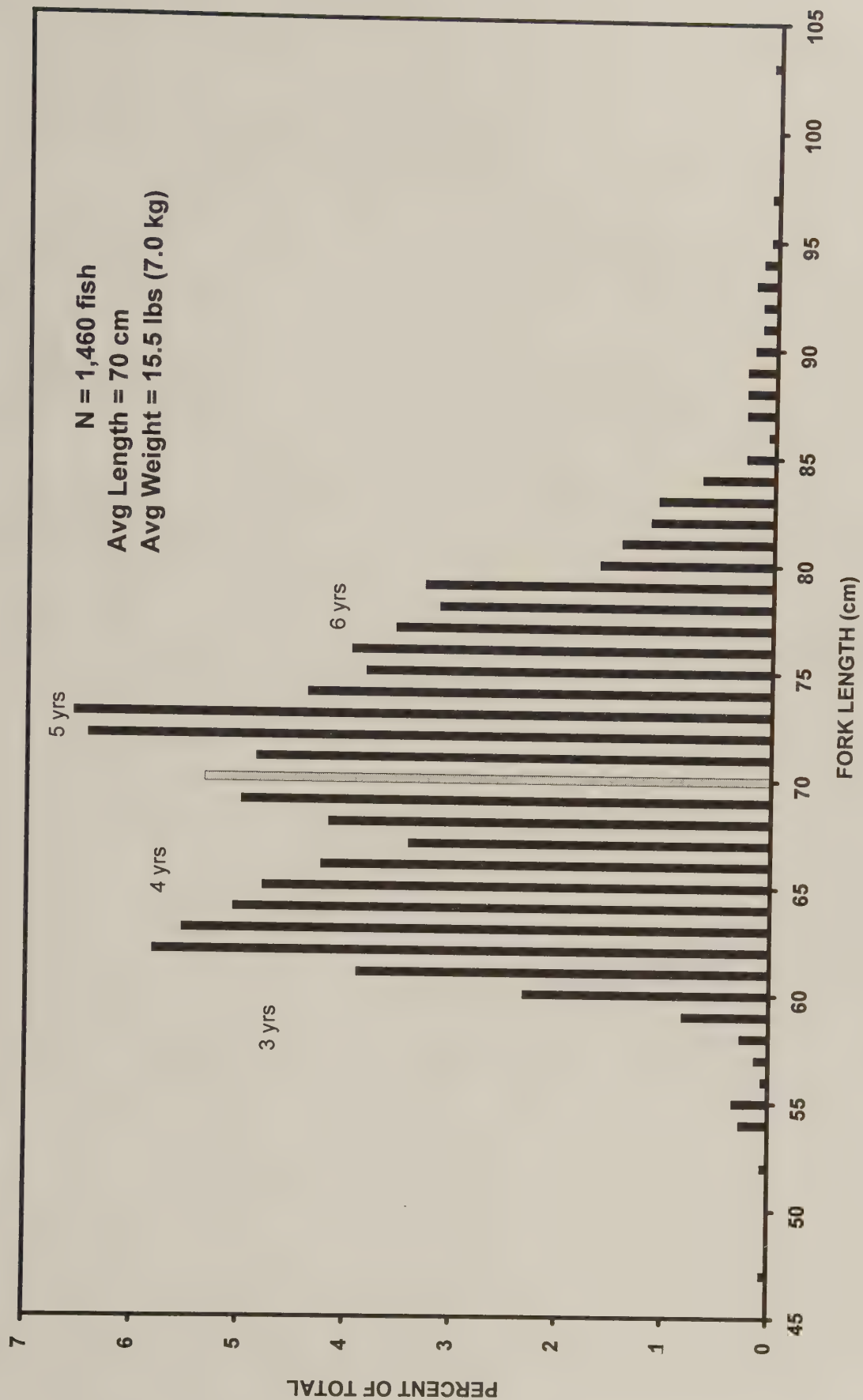


Figure 6. Length-frequencies of albacore sampled from the 1994-95 South Pacific troll fishery.

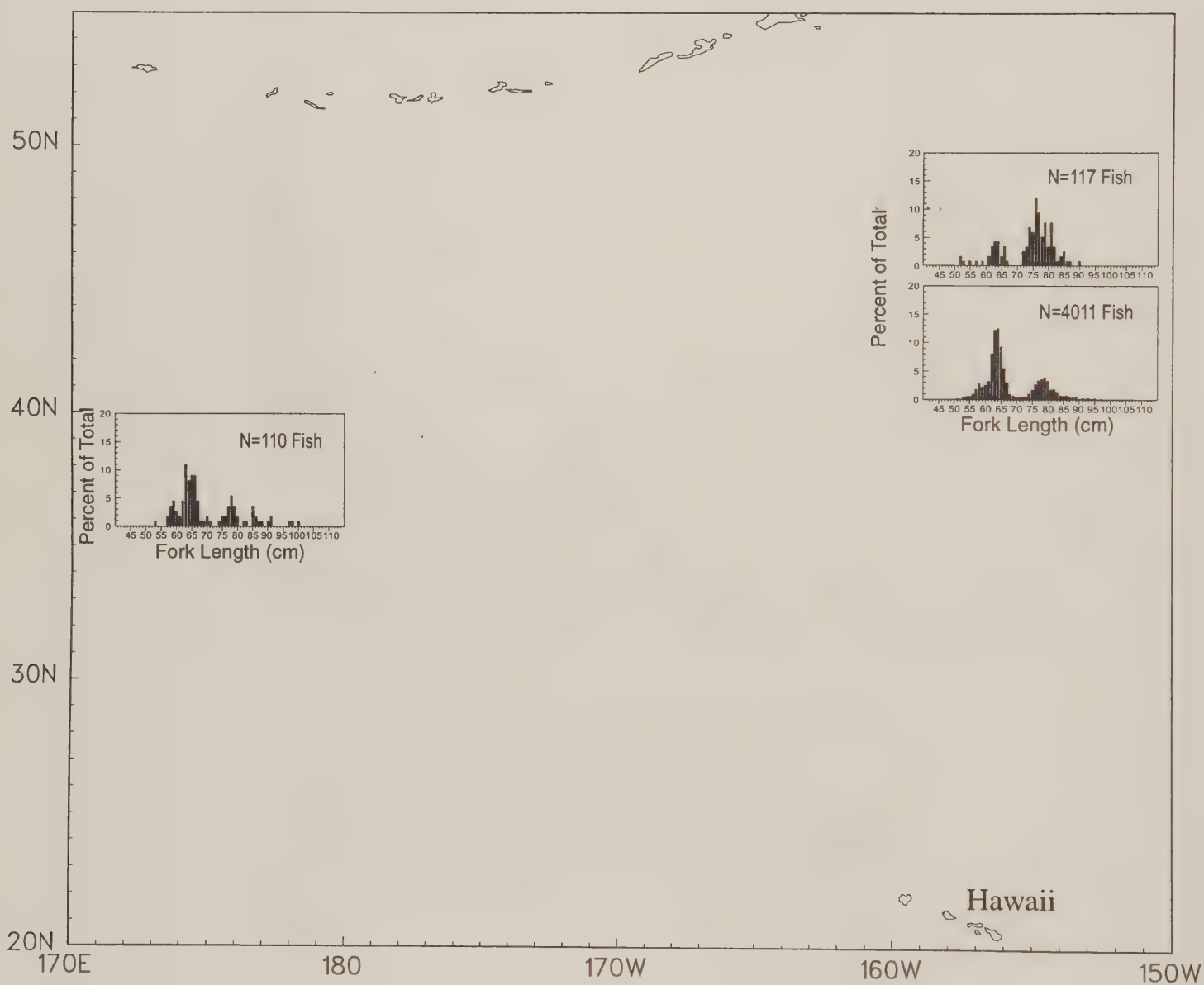


Figure 7. Size distribution of albacore sampled from the 1995 North Pacific troll fishery summarized by 5°x10° quadrangles.

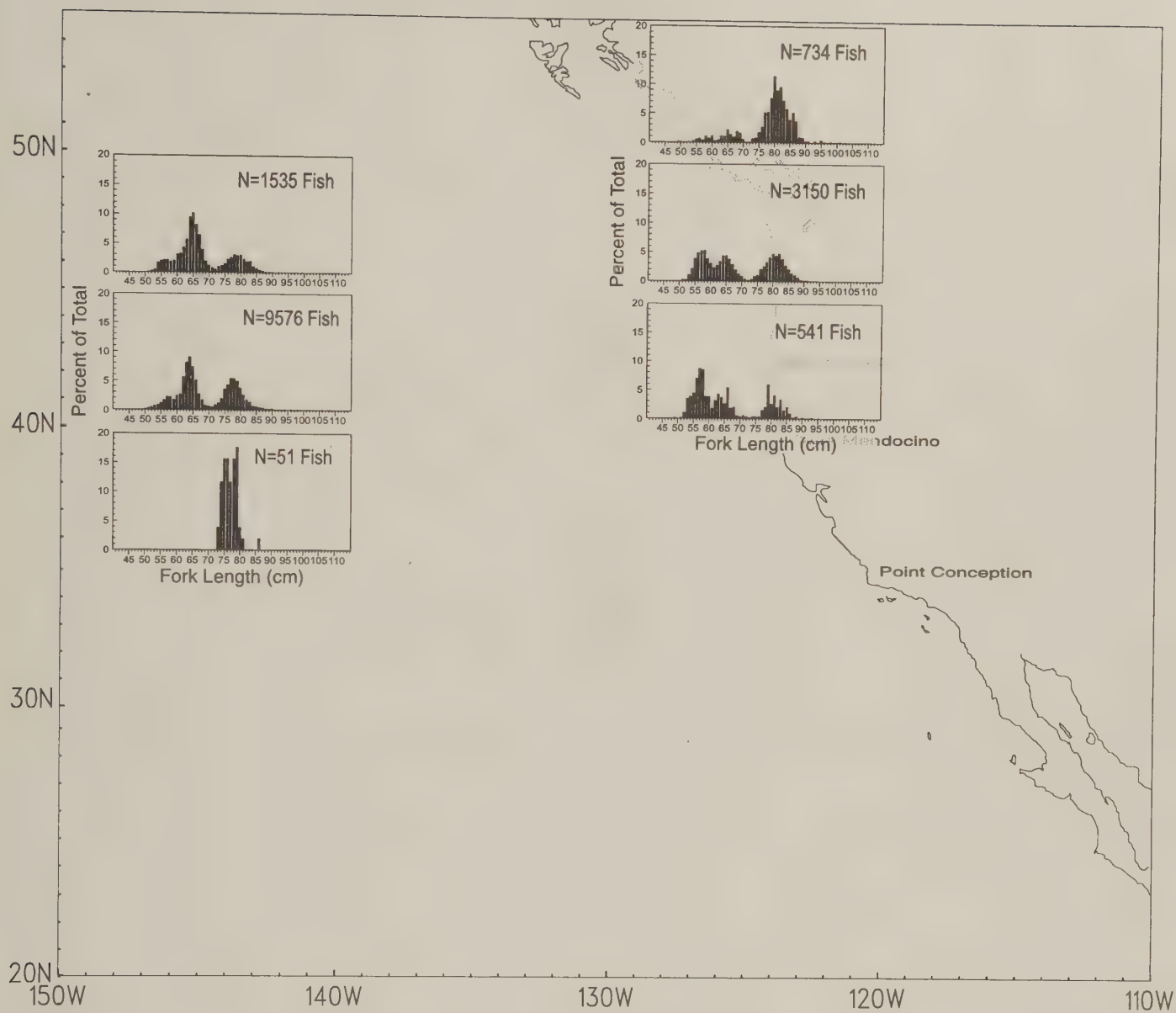


Figure 7. (continued).

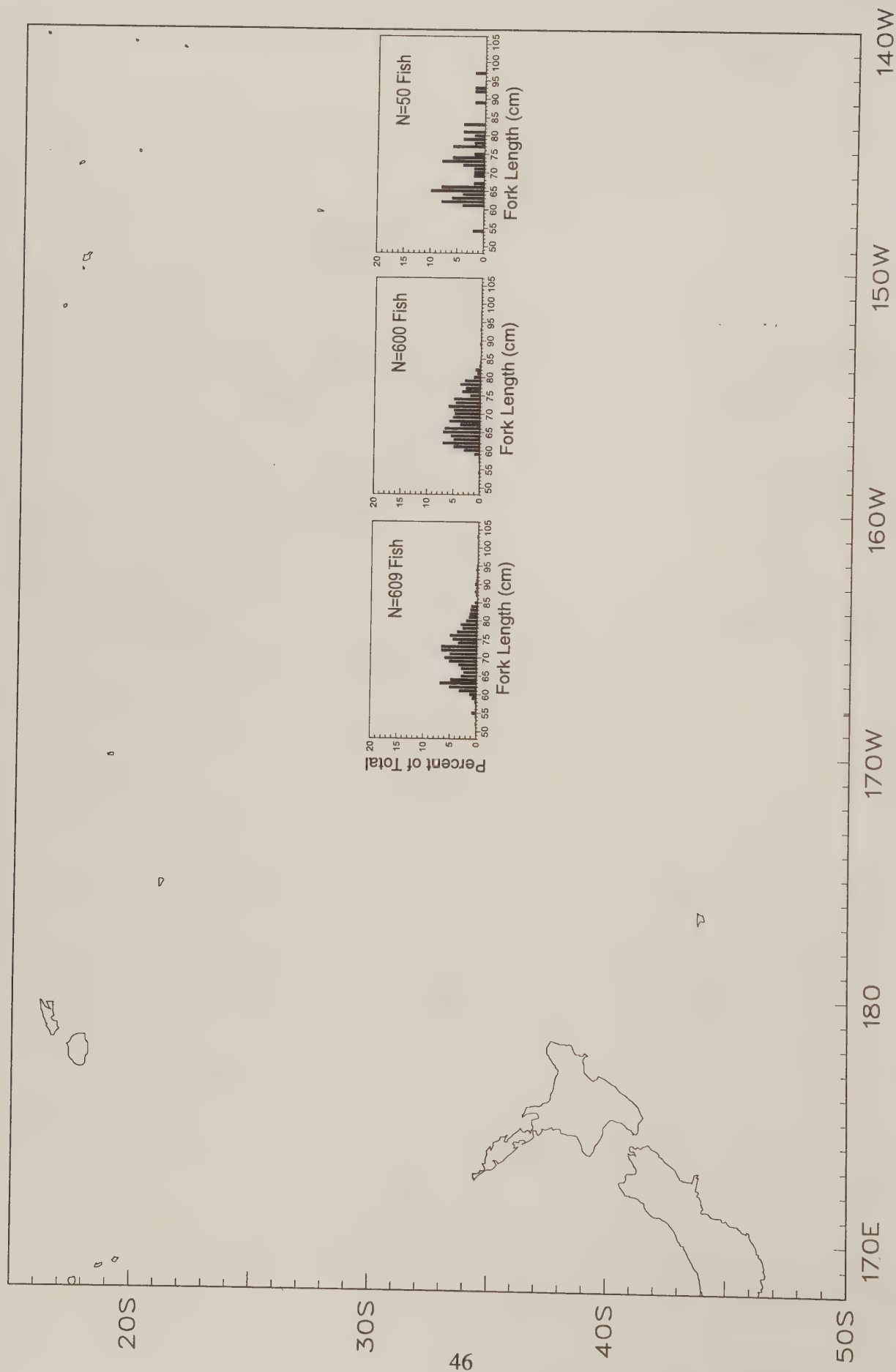


Figure 8. Size distribution of albacore sampled from the 1994-95 South Pacific troll fishery summarized by 5°x10° quadrangles.

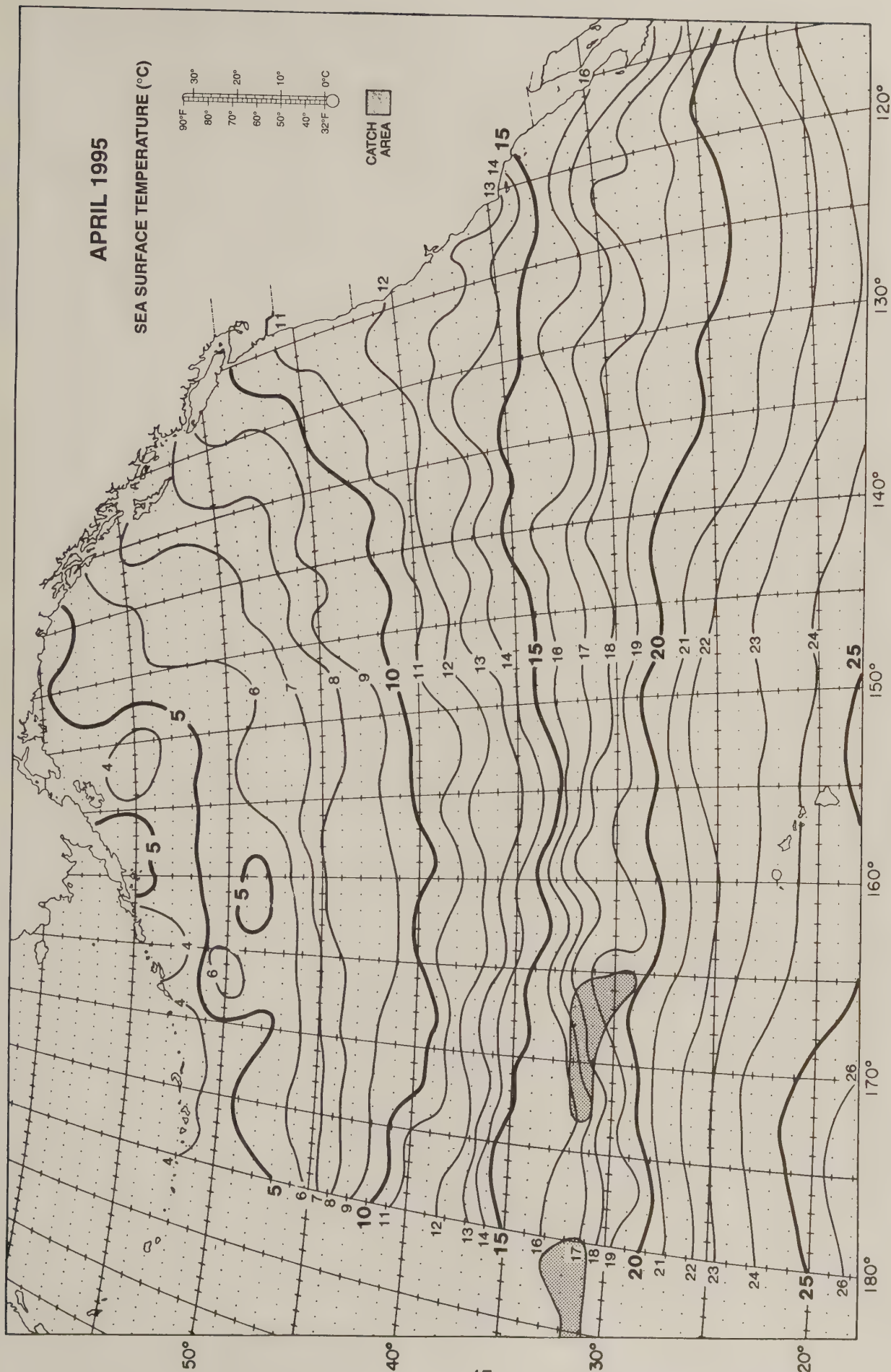


Figure 9a. Average SST isotherms and general catch area of North Pacific albacore troll fleet for April 1995.

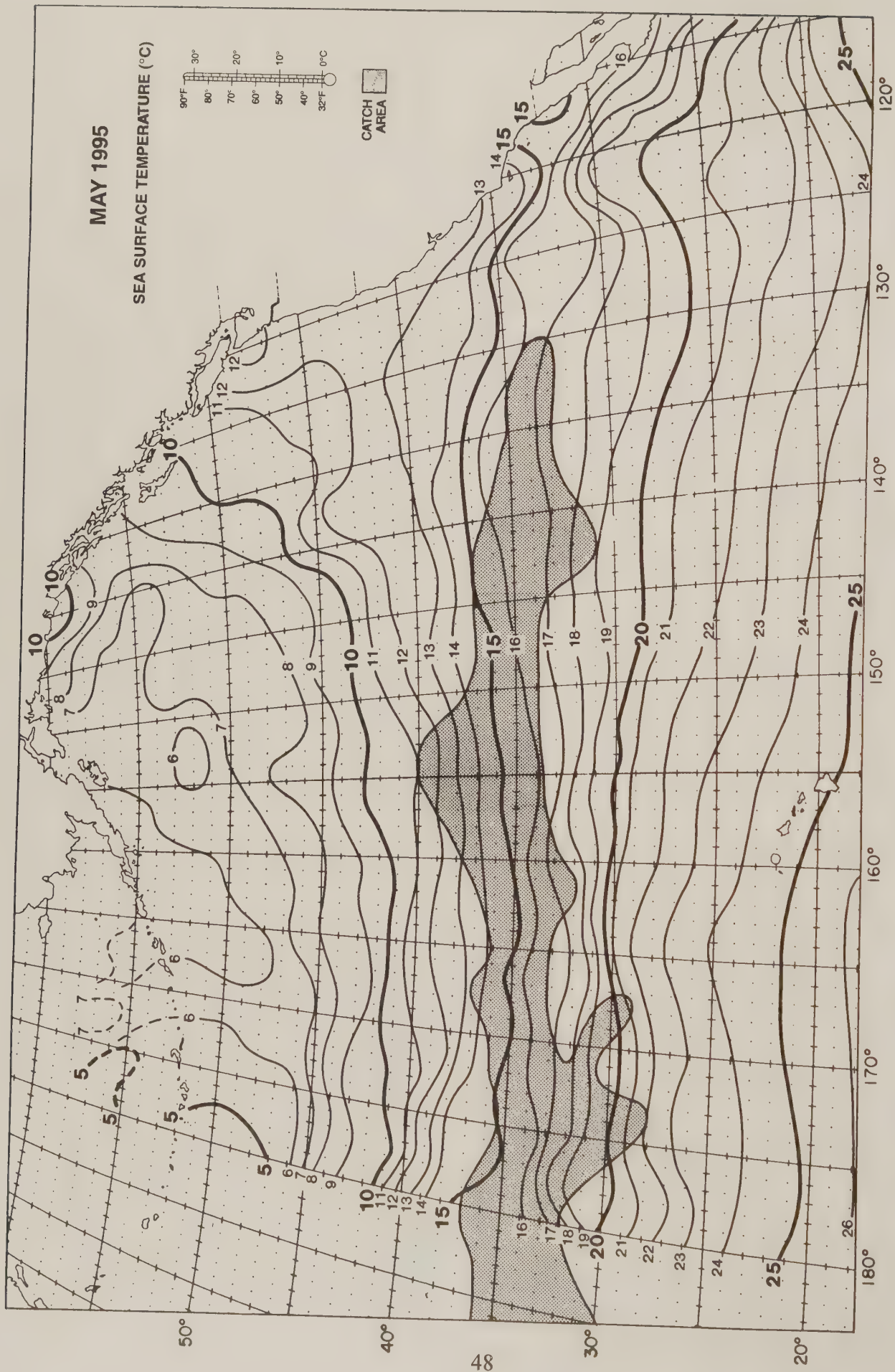


Figure 9b. Average SST isotherms and general catch area of North Pacific albacore troll fleet for May 1995.

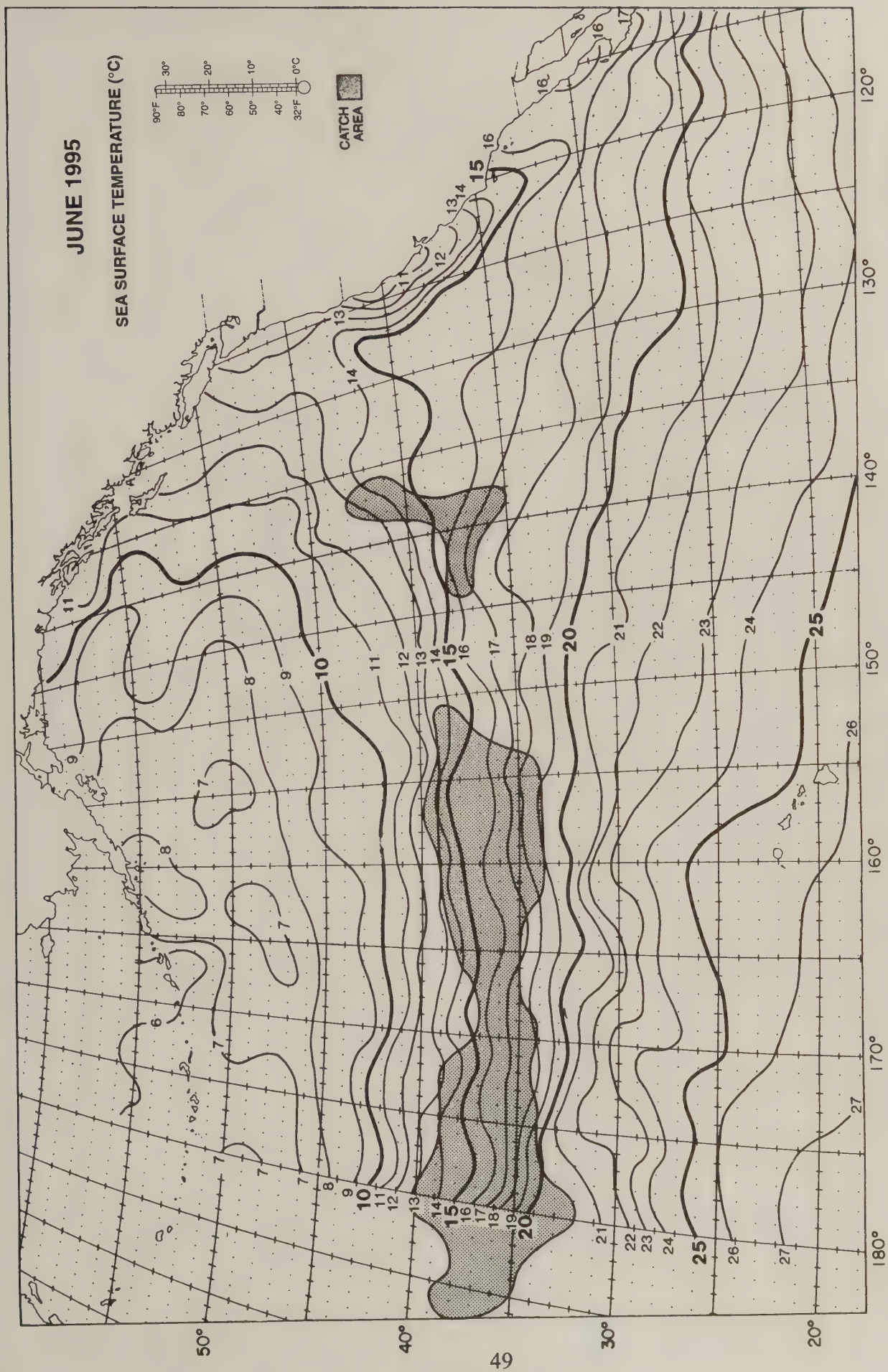


Figure 9c. Average SST isotherms and general catch area of North Pacific albacore troll fleet for June 1995.

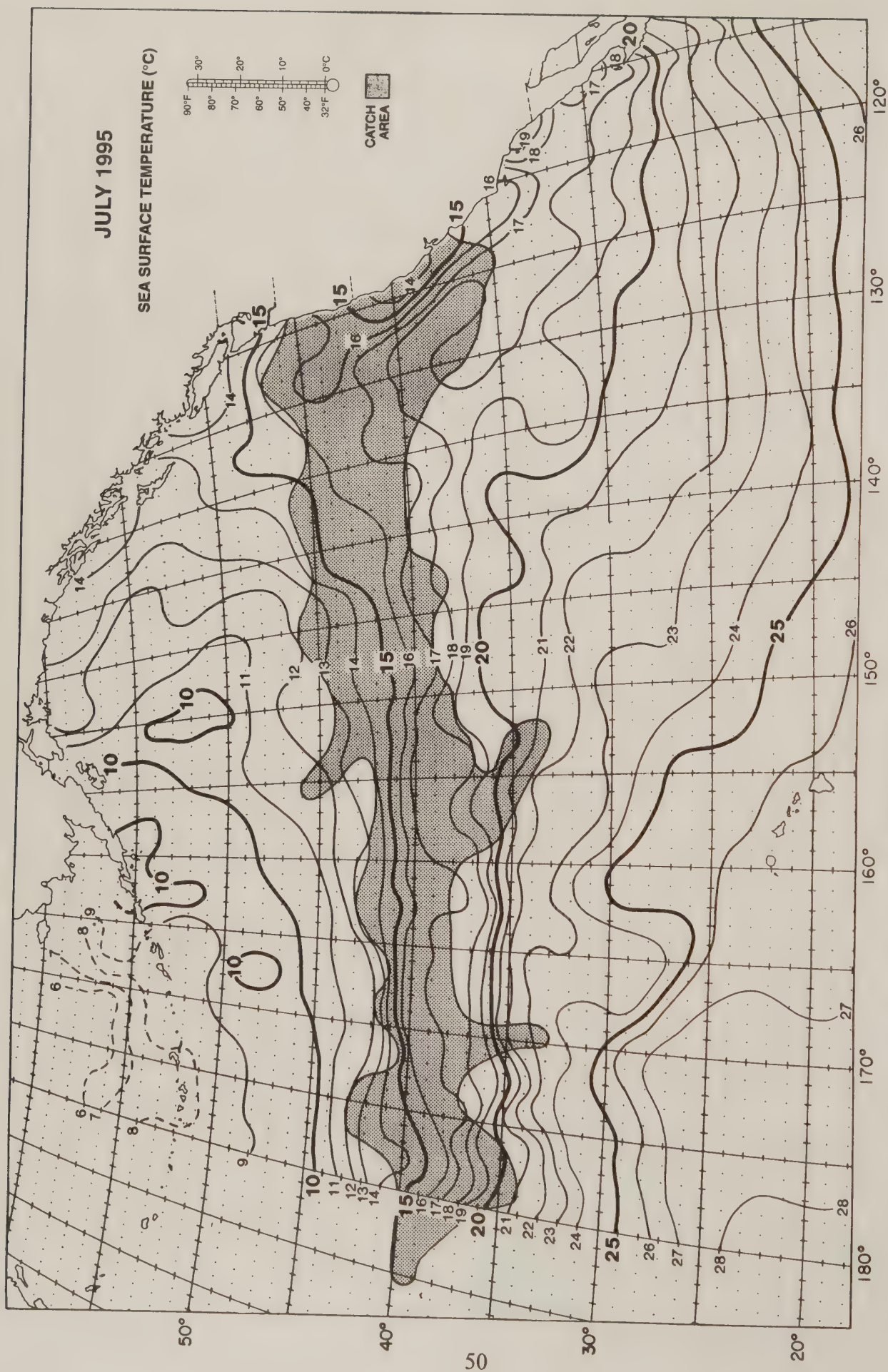


Figure 9d. Average SST isotherms and general catch area of North Pacific albacore troll fleet for July 1995.

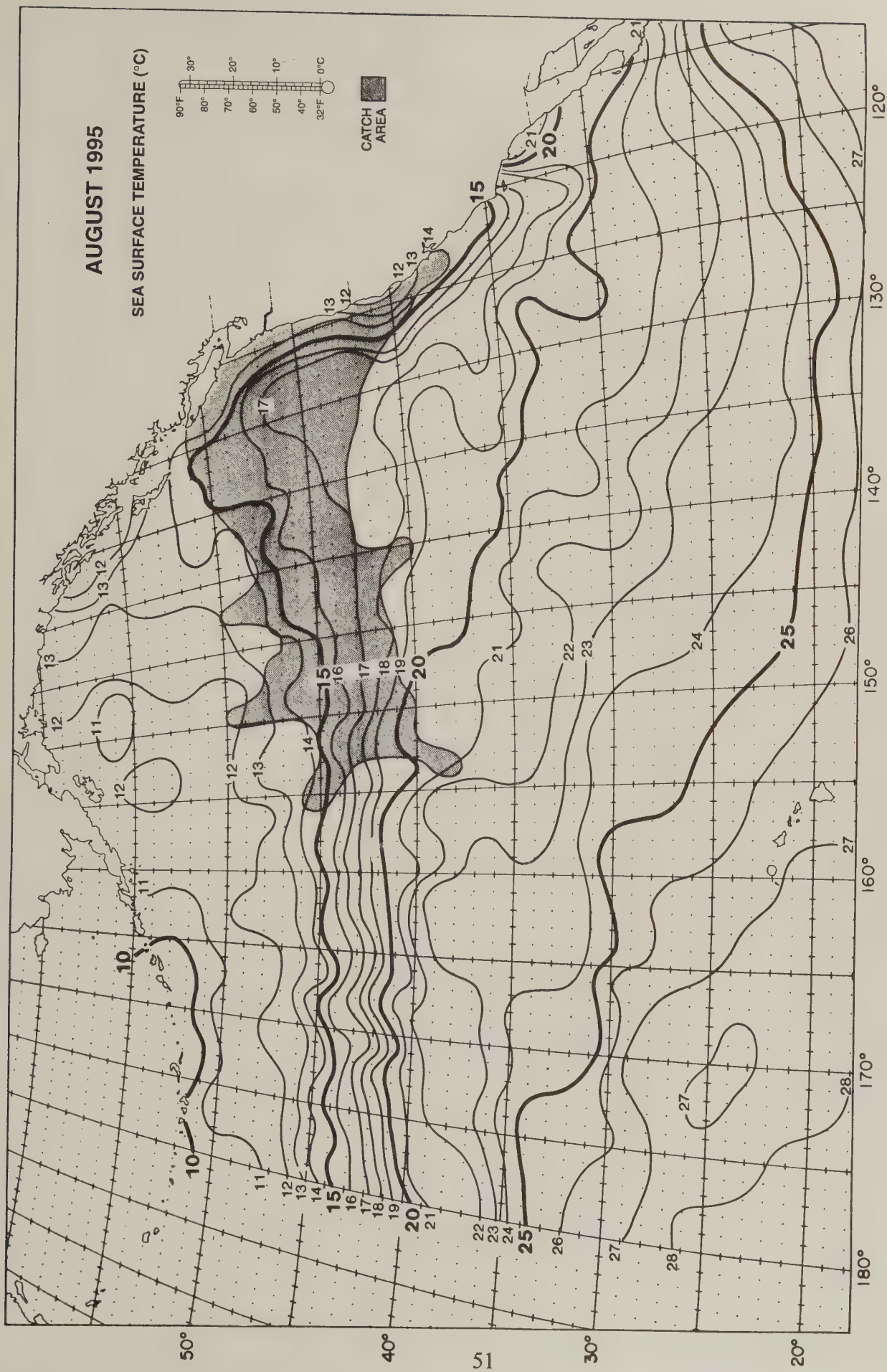


Figure 9e. Average SST isotherms and general catch area of North Pacific albacore troll fleet for August 1995.

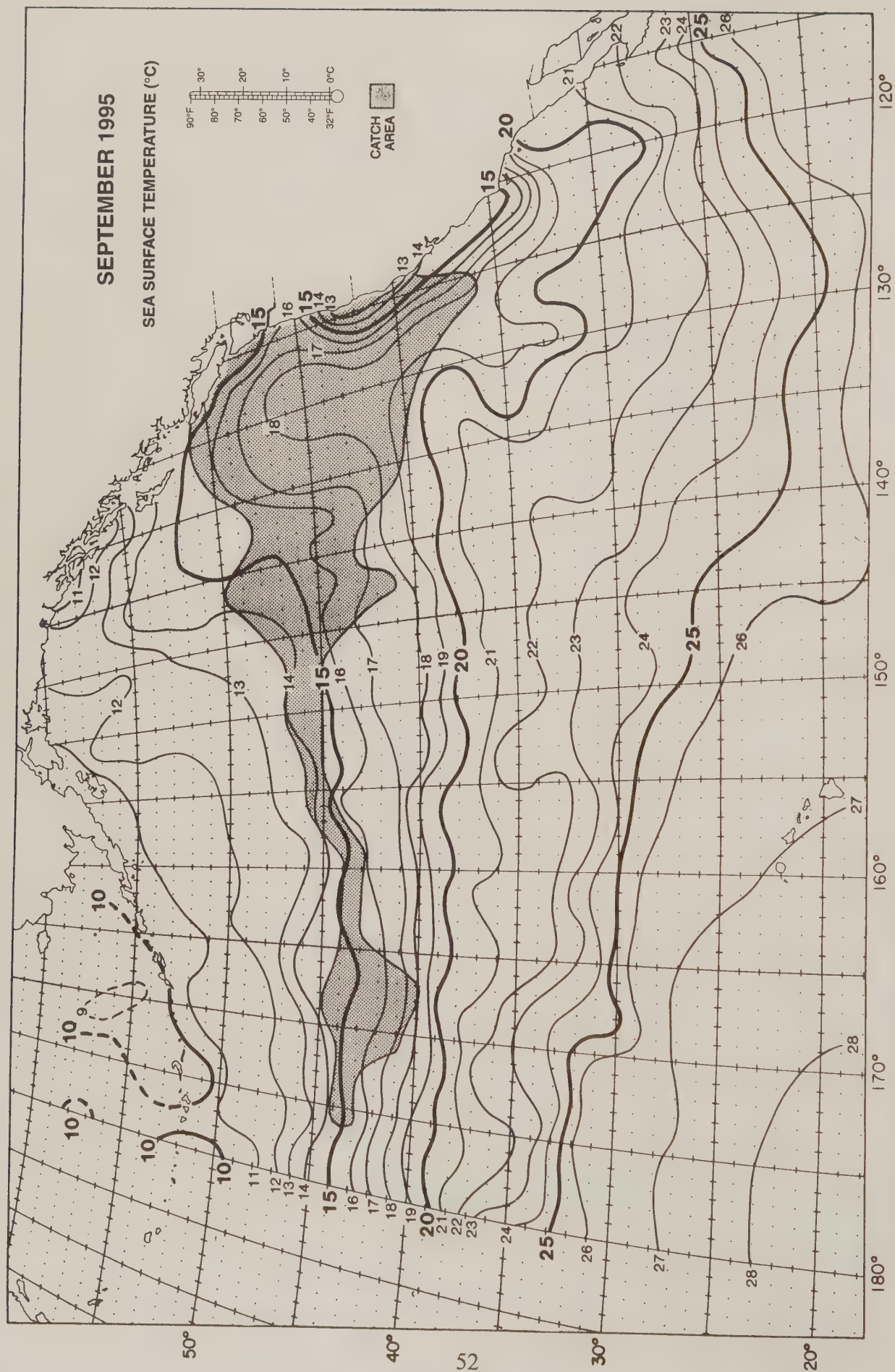


Figure 9f. Average SST isotherms and general catch area of North Pacific albacore troll fleet for September 1995.

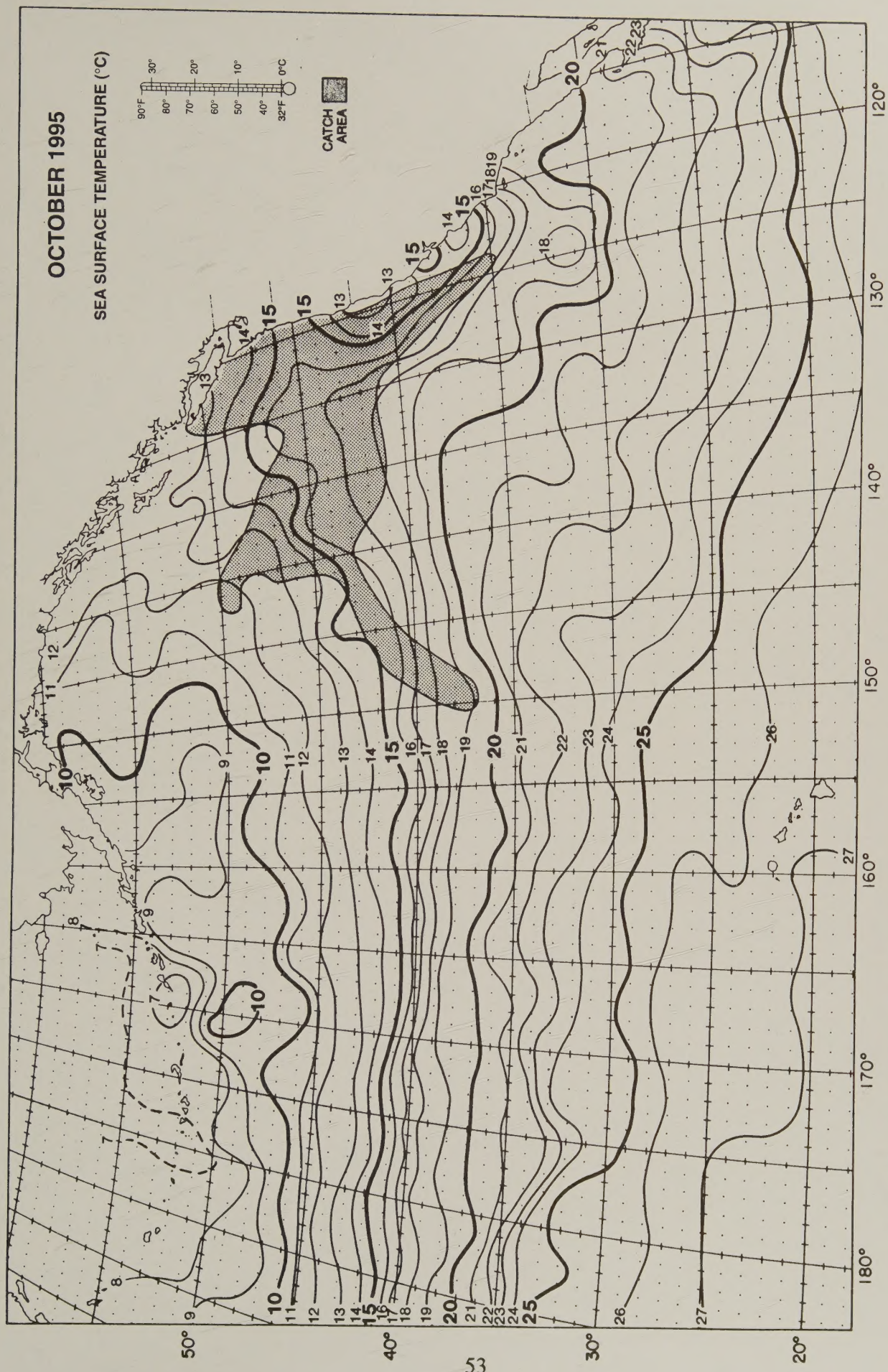


Figure 9g. Average SST isotherms and general catch area of North Pacific albacore troll fleet for October 1995.





